

# AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL

DECEMBER, 1896.

## THE ALTOONA SHOPS OF THE PENNSYLVANIA RAILROAD.

### VI.

(Continued from page 284.)

#### PIECE-WORK.

In nearly, or quite, all of the shops at Altoona, work is now done by piece-work, and almost all of it, even to such service as handling coal and ashes, cleaning the tubes of locomotives, washing windows, etc., has now been brought under that system. This was introduced at Altoona in a sort of rudimentary form as much as 25 years ago, and has been thoroughly tested and perfected since, and its great advantages have, it is thought by those who are in charge of the shops, been thoroughly demonstrated during that period, and they would as soon think of substituting the old hook valve-gear for the link-motion, or replacing injectors with pumps, or steel tires with those made of cast-iron, as of going back to the day-work system in their shops. Now, one of two things is certain, either those in charge of the machinery, the shops and the work at Altoona are very much deluded with reference to the advantages of that method of doing work, or those who are responsible for the management of other similar establishments are very blind in not adopting it, or, at least, acquainting themselves with the working and merits of that system.

It is claimed for it—and apparently on grounds which cannot be disputed—that it doubles the output of work from a given equipment and a given number of men. In proof of the latter it is said that in the old shops at Altoona, before work was done in this way, 50 new locomotives were built in a year. After piece-work was introduced 100 were built in the same time, with substantially the same tools and appliances and the same number of men. An equal increase has been made in the output of repair work in the locomotive and car shops.

As an illustration the following case was cited by one of the foremen: In 1880, in making the general repairs to locomotives, a gang of 32 men were employed for every three engines. By days-work it then took 28 days to rebuild three engines and the work in the erecting shop cost \$270 per engine. When piece-work was first introduced 14 men and 2 apprentices were employed to do the same work and it cost 20 per cent. less. Now this work is done by 9 men, 3 apprentices and 1 laborer in 14 days and the labor costs \$90 per engine.

In the construction of new engines the difference is equally as marked as in repair work. The cost of day's work in the erecting shops of what are known as class I engines was \$290. Engines of the same general class, but about 15 tons heavier, now cost \$95.75, and are done in half the time. Substantially the same equipment, such as traveling cranes was employed under both systems, although some appliances and methods for doing work economically were devised and adopted by the men and their foremen in order to facilitate and expedite what they were doing. By day's work it took three days to build a box-car; now it is done in 14 or 15 hours. The pipe-work on a locomotive formerly cost \$197, and now costs \$32.

In making up the schedule of prices for piece-work from the cost by the day's-work system a primary reduction of 25 per cent. was made. Since then other reductions in prices have followed, so that now, as has been stated, the cost of labor in the Pennsylvania shops has been reduced one-half, and the output of work by a given equipment and number of men has been doubled. If

these statements have any basis of fact to rest upon, they are surely worthy of serious consideration by those who control similar expenditures in other great enterprises.

Another advantage is that the men make a great deal more money, in a given time, under the piece-work system than they do when working by day work; they are more interested in what they are doing, become more efficient in their duties and are better content in their positions. No driving of the men is required, because if any of them are disposed to loiter or "loaf"—as expressed in workshop vernacular—the time thus wasted is their own loss. To a great extent they can enjoy the independence of controlling their own time, and none excepting those who have endured it know how irksome it becomes in time to be tied down to fixed hours and inexorable conditions of service.

Another effect of the system is that it stimulates the ingenuity of the men to devise new methods and appliances for doing and handling work. They resort to all kinds of expedients to facilitate what they have to do and increase their output. This was especially noticeable in the blacksmith shop at the car works. In modern car construction many forgings of more or less complicated forms are required. To make these a great variety of formers, dies, clamps, etc., are needed, and each man who is paid for the number of pieces he can make in a day is interested in devising new appliances which will facilitate the doing of his work. A very interesting book might be written describing the means employed in this shop and showing how the different kinds of forgings are made.

It also results in a complete differentiation of capacity. That is if a man has any kind of special skill or aptitude, he is employed only on work which requires such skill, while that which can be done by mechanics of a lower grade, or by ordinary laborers, is assigned to men of that class. In that way a process of specialization is instituted, which, to a great extent, becomes automatic in its action, so that each man does what he is best suited for. It also results in the speedy weeding out of the incapables and the unworthy.

If honestly and justly administered, it removes some of the chief causes of disputes between the men and their employers, and substitutes "sweet reasonableness" for contention and acrimony.

The first objection, which is made by those who have little or no knowledge or experience with the practical working of this system, is that it results in bad workmanship, and it is assumed that it is an utterly hopeless task to undertake to so classify all the multifarious operations required to repair locomotives or cars, as to be able to assign a fair price for each distinct operation. Some idea of the complexity of this task may be formed when it is said that in the locomotive erecting shops there are 180 separate items and prices for stripping an old engine and 360 for erecting it anew. Besides locomotive work considerable is done in this shop on signals, water-stations etc., for all of which there are separate scales of prices, making about 1,000 items in this one shop. In all the locomotive repair shops there are probably from fifteen to twenty thousand distinct prices and at the car and Juniata shops as many more. Only about one per cent. of the work in the erecting shops is done by days work. In the boiler shops there is a price assigned for putting in stay-bolts; riveted work is counted at so much per rivet, caulking and flanging is paid at a given price per foot.

The following are some of the items taken at random from the schedule of prices in the boiler shops, the prices themselves being omitted:

#### PATCHING BOILERS AND FIREBOXES.

Putting in cheek patches and other small patches with less than 20 rivets, per rivet.....  
For larger patches in boilers and fireboxes—for first 30 rivets, per rivet.....  
All over 30 rivets in same patch, per rivet.....  
Putting new bottom in smokebox 65 to 80 inches long.....

#### ASH-PAN REPAIRS.

General repairs to include new side sheets or sides straightened and patched, bottom straightened and patched, new shields, top and bottom, new collar pieces or collar straightened, one back plate, side pocket and lid straightened, new damper bearings.  
Ash-pan cleaned and painted, classes J, K, P and R, each.....  
Flanging ash-pan collar.....  
damper.....

Examining boiler and stays	.....
firebox and staybolts	.....
Cutting out old brace and fitting and riveting new one	.....
Making new brace	.....
Cutting out old crow-foot and fitting new one	.....
Renewing bolts in sling stays; for the first 4 bolts each	.....
Over 4 bolts and up to 8	.....
All over 8 bolts	.....
Renewing stay bolts in erecting shop for first bolt	.....
For second bolt	.....
All additional up to 50	.....
All over 50 in same engine	.....
Riveting leaking stay-bolts	.....
Cutting out old back flue sheet and fitting in new one	.....
Chipping, riveting and caulking back flue sheet	.....
Caulking hot boiler in erecting shop	.....
Repairing fire door	.....
" " and frame	.....
" " catch	.....
" " latch	.....

About 250 men are employed in the boiler shops and two clerks are required to keep the accounts. Here, too, the schedule of prices includes about 1,000 items.

In the repair of old cars and the construction of new ones piece-work is employed, as in all the other shops. Probably many of our readers entertain the same opinion that the writer did before investigating this subject which was that in the repair of cars there would be such a multiplicity of different defects and operations that it would be impracticable or impossible to make a schedule of prices covering all the work to be done. Experience has, however, shown that car disorders are analogous to the diseases of human beings. They are not all afflicted with the same ailments, but there are various kinds of infirmities from any one of which many people and many cars may suffer. The diseases of men, women, children and cars may all be reduced to classes and sub-classes, and the remedies are the same in all similar cases. This makes it possible by intelligently analyzing the repairs of cars, to make schedules of prices which will cover all the infirmities to which they are subject. Of course, making such a schedule and fixing rates which would be fair to both parties to the transaction was a task of gigantic proportion and could only be worked out by the exercise of the most intelligent and painstaking care and an unwavering disposition to do justice to both sides.

In the erection of new cars and the repair of old ones the men work in gangs of about ten, and the work done is credited to the gang and then divided up among the individuals who compose it. In all cases where work can be done to better advantage by the co-operation of a number of men this system is adopted. If men of different degrees of skill are employed on one job, as where helpers or laborers compose part of the gang, these get a smaller proportion of the earnings according to their rating.

The persons best able to judge of the efficiency of piece-work are the shop foremen. In going through the different departments careful inquiry of the men in charge of them was made with reference to this point. All were agreed that the amount of work turned out was immensely increased by piece-work, and the cost greatly reduced. This reduction was estimated by different foremen at from 33½ to 65 per cent. The information obtained in the car works confirmed what was learned in the locomotive department. If anything the increased output in car repairs and construction and the reduction in cost is greater than it is in the locomotive shops. Surely such facts as these cannot be disregarded by those in charge of railroads whose work is done under the old system of day labor. With the advantages which result from the adoption of the piece-work system before us, it would be just as reasonable to object to the use of locomotives because each one with its tender consists of over 12,000 or 15,000 separate prices, as it is to condemn the piece-work system because that number of pieces are required in doing work under it, or a man for a similar reason might object to wearing a pair of trousers because if they were unravelled they would consist of some thousand separate threads and perhaps millions of distinct fibers of wool. The fact is, as Herbert Spencer has explained, evolution is "from the homogeneous to the heterogeneous," and in highly developed enterprises complexity becomes unavoidable.

Undoubtedly the risk of bad workmanship under the piece-work system must be encountered, but for this an adequate and effective method and organization for the inspection of work is found to be a sufficient safeguard. The success of the system is dependent upon such inspection. Without it piece-work is as

impracticable as civil government would be without a judicial department. The fact that skillful, honest and intelligent inspection is required in doing piece-work is no more valid objection to it than it would be to find fault with civil government, because the same characteristics are required in our courts and judges. It should be recognized at the outset that piece-work is impracticable without adequate inspection, and without it it will fail utterly. Great care, labor, integrity of purpose and patience in its organization and in formulating scales of prices, in the classification of work and its general supervision, are required. It must be admitted that much more intelligent supervision is needed to introduce and maintain it successfully, than is demanded with the ordinary method of so much pay for so many days or hours of work. Any disposition on the part of those in charge of shops to deal unfairly with the system or "beat" the men, or to lower the prices so much that they cannot earn somewhat more than they can by days work, is certain to defeat itself. The piece-work system must be conducted justly, intelligently and impartially, and unless it is it is unworkable, and will fail. Do the results compensate for the employment of a much higher order of intelligence in its supervision?

One purpose of this article is to answer this question, and another will be to describe how the system has been introduced, how it works, and what the results are.

At first sight it may appear, as has been intimated, as though a subdivision of the multifarious operations involved in the construction and repair of locomotives into distinct operations, and assigning a price to each which will be fair and just under all the conditions which arise, would be utterly hopeless. That it is difficult to do this must be admitted, and that an enormous amount of labor, time, patience, knowledge, intelligence and integrity of purpose had to be expended in creating a system like that which now exists in the Altoona shops is also true. The magnitude and complexity of the undertaking will be indicated by an enumeration of some of the different trades and occupations in which the employees are engaged. Among these are machinists, blacksmiths, boiler-makers, iron and brass founders, carpenters, tinsmiths, sheet-iron workers, painters, upholsterers, etc. It may be thought, too, that while the system is practicable on a road like the Pennsylvania, where a great deal of new work is done, and standards of construction have been adopted to a greater extent than on most other roads, it may not be workable on other lines equipped with a larger variety of rolling stock and which do only repair work. As a matter of fact, there are more classes of engines on the Pennsylvania road than may be supposed. These are designated by letters and are as follows, the numbers preceding the letters indicating the number of varieties in the class: 2 A, B, B A, C, C A, 2 D, E, F, G, H, I, 2 K, L, 3 M, N, 5 O, 7 P, 2 Q, 4 R, and N. In some of these classes there are, of course, many engines which are substantially alike, and which, of course, facilitates the operation of the piece-work system. But we have here 20 classes, and besides these 25 sub-classes, all of which are repaired under the piece-work system.

Doubtless it will occur to the reader, as it did to the writer, to inquire how the system was devised and introduced and perfected. Through the courtesy of Mr. Casanave, the General Superintendent of Motive Power, and the heads of different departments and shops, who granted the privilege of investigating the subject, and of asking innumerable questions, and who answered them with a degree of patience which only Job could emulate, we have been able to obtain some idea of how the system was evolved and perfected. Although piece-work had been in vogue to a limited extent for a number of years preceding its general introduction it was not until 1880 and thereafter that it was thoroughly systematized and introduced into most of the departments. At that time Mr. Casanave was Assistant Master Mechanic in the shops, and he was largely instrumental in extending it generally in all the departments.

The method pursued was this—the work in some one department, like that of the erection of a locomotive, was selected and the separate operations or "jobs" were divided and subdivided, and a careful account was kept of the time expended on each

and the cost of the time. This was repeated a sufficient number of times until it was certain that the average cost had been ascertained, and that the subdivision had been carried far enough to establish and apportion the prices for doing work. Those for piece-work were then fixed about 25 per cent. lower than the cost by day's work, and this schedule was then put in operation. It of course required a great deal of subsequent revision, which had to be done with the most conscientious care and intelligence, and with a disposition to deal fairly with both the men and the company. Prices had to be revised, and the classification changed whenever experience indicated it was required. This has been the work of years and the system still requires occasional revision. After piece-work had been adopted for some time, and the men had shown how much work they could do, further reductions in the prices were made, care being taken that by diligence the men could still earn more money than they would by day's work. It should be said here that each man is rated at a certain price per hour, at which rate he is paid when it is necessary to do time work, and an account is always kept of both the time occupied and the amount of work done, and his compensation is estimated in both ways to indicate whether the prices are excessive or too low. The following figures taken at random from a book in the boiler shop indicates the earnings of ten men for the month of June estimated in both ways. Of course they were paid piece-work prices:

Earnings estimated by day's work.	Earnings estimated by piece-work.	Earnings estimated by day's work.	Earnings estimated by piece-work.
\$45.25	\$33.81	\$20.76	\$24.72
39.82	47.41	22.26	26.50
20.76	24.72	24.78	29.50
35.40	42.14	31.40	40.96
15.12	18.00	20.52	24.44

During this period the shops were running short time, but it will be seen that the earnings of these men were considerably greater—nearly twenty per cent.—by piece-work than it would have been by day's work. Consequently piece-work is very popular with the workmen, and any proposal to abandon it and return to the system of day's work would be resisted and met with general disapproval and discontent.

Another cause of its popularity is the greater independence which it gives to the men. If any of them are suffering from malaria, lumbago or pain in the stomach, and is disinclined to work hard, it is his own affair. If disposed to condemn any pernicious political doctrines or candidates such as those advocated by the late Mr. Bryan, during working hours, a workman may do so without let or hindrance. It removes both the fact and the feeling of being driven by a taskmaster, and substitutes a sense of freedom for a feeling of servitude.

One of the results of the piece-work system, it is said, is that there are no trades-unions in Altoona, but there are many building associations and churches which are prosperous. The increased earnings of the men enables many of them to own their own houses.

One of the objections which have been made to piece work is that the men over-exert themselves and finally break down, and on this ground it has been often opposed by many of the trades-unions. This evil has appeared at times in the Altoona shops, but it is said can easily be checked. Of course, if those who are in control reduce prices too much, it will compel men to over-exertion in order to earn adequate wages, which leads to the repetition of the statement that piece-work is practicable only where those in charge are disposed to deal fairly with those under their control, the moral of which is that geese which lay golden eggs should not be slaughtered.

Among the useful organizations at Altoona is a foremen's association, at which papers are read and discussed which relate to their various occupations and duties. At one of their meetings Mr. Thos. McKernan, General Foreman of Carpenters, read a paper in which he referred to one of the incidental disadvantages of the piece-work system which is worthy of consideration. It relates to that much-neglected individual, the apprentice. In the course of his observations Mr. McKernan said:

"That the piece-work system which has been established in the shops (though a very good thing in many ways) has a tendency to operate against the apprentice is manifest without explanation,

The foreman does not always do his duty by the apprentice: the boy is not seen for days, neither inquiry is made as to how he is getting along, nor encouragement given him. This is not right, but decidedly wrong; for there is a moral obligation that every foreman assumes as foreman, to teach the apprentice a trade, and the foreman should do his best for the boy. A modest, unassuming lad frequently becomes discouraged; matters do not go right and he does not like to ask the journeymen, for he might receive the answer, 'I have no time.' The apprentice wants the sympathy and encouragement of his foreman. The foreman should talk and sympathize with him, and reach his better nature, stirring in his soul a sense of confidence, infusing in his young mind new desires, and encouraging him to have a higher aim and a nobler ambition.'

There certainly is much force in this statement. Those of us who can remember the bleak desolation of our early apprenticeship, the dreadful feeling of isolation and loneliness which comes to a boy when he is first cut loose from home and friends, will sympathize with Mr. McKernan's remarks. That the evil, though, is remediable seems plain. The piece-work system demands the services of inspectors of work; these might be delegated with the additional duties of instructors of apprentices. Piece-work probably fosters, to a greater or lesser extent, the principle of every man for himself and the devil take the hindmost. What seems to be needed is a kind of supplemental good angels to look after young apprentices. It should never be forgotten that these neglected people of to-day are those who stand behind us and will certainly slip into our shoes in that very near future when we will be expected to step down and out.

As an illustration of the educational influence of piece-work it was told the writer that it often happens that men are put to work in gangs in which each man is entitled to a certain percentage of the earnings of the gang. The mathematical knowledge of some of these men is often so limited that they do not know how to calculate their proportion of the earnings. It is said that under the stimulus of this system, in a very few months, the most ignorant men learn how to calculate percentages as well as the best of them.

Another amusing incident was related. When piece-work was first introduced into the locomotive shops the W. C. accommodations were considered insufficient for the number of men who used them, and it was intended to extend their precincts. After the new system it was found that they were ample and there was room to spare.

Piece-work withal is very popular with the men, and, as one of the foremen remarked, a proposal to return to the day's work system would probably produce a strike. Wherever, as is sometimes the case, it is necessary to put men at work temporarily, on day's work, it causes grumbling and dissatisfaction. On careful enquiry among, not only the heads of the various departments, but of the foremen of the various shops, it was found that the saving in the cost of work was estimated at from 35 to 65 per cent., and all were agreed that the amount of work turned out was doubled. The possibility of halving the cost of labor and doubling the output of work in a railroad shop is a result which certainly ought to be worthy of investigation by those who control expenditures, especially when the system may be introduced in a partial and experimental way with so little risk.

To illustrate the importance of this, it may be said that the cost of maintenance of equipment on the Pennsylvania Railroad last year was, in round figures, \$9,500,000. About half of this cost, or \$4,750,000, was for labor. To reduce this one-half or even a quarter is an object worth accomplishing. Besides such a saving an increase of business would be sure to demand additional shops, tools and other facilities for doing repairs before long. If the capacity of existing shops and their equipment can be doubled, as it is claimed in Altoona it has been in their shops, the extension may be postponed for a decade or longer. There is only one difficulty in the way of its introduction and successful operation in any railroad shops, that is the need of intelligent, careful, faithful and *righteous* supervision, without which it is doomed to failure. It is because it has had this in Altoona that it has succeeded to the extent it has.

It may be added, in the form of a postscript, that the information with reference to the results attained by the piece-work system in Altoona was not obtained from any one source, but was the result of independent interviews with the heads of different

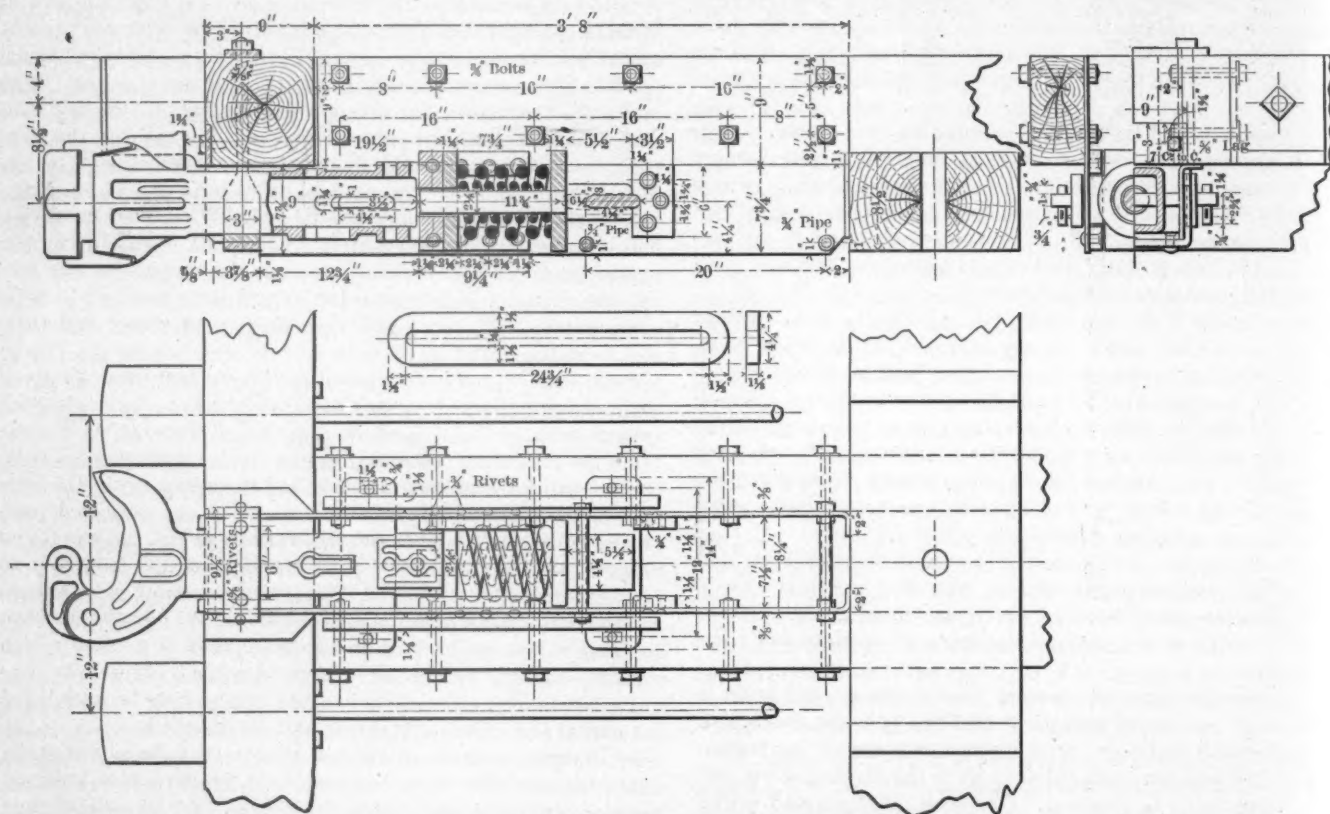
departments, beginning with the General Superintendent of Motive Power, Master Mechanic, the foremen of most of the principal shops, the workmen themselves and independent observation of the writer. As remarked in the beginning of this article—either *all* these people are very much deluded with reference to what they are doing or the economy which results from paying for work done by the piece, instead of by the day or hour, is a matter of very great importance to all railroad companies and their stockholders.

## A New Freight Draft Gear.

Mr. J. G. Tomlinson, Superintendent of Motive Power of the Queen & Crescent Route at Meridian, Miss., has had in service for the past 13 months several cars equipped with a new draft gear designed by him, and from drawings kindly supplied by him we have made the accompanying engraving. It shows the draft gear in vertical section and in inverted plan. The first thing to be noted is that the usual draft timbers are omitted and their places taken by  $\frac{3}{4}$ -inch steel plates, which are bolted on the inner faces of the center sills and extend  $7\frac{1}{2}$  inches below them. These plates are flanged against the inner face of the end sill and also against the body bolster. They extend under the end sill to its outer face and have flanges bearing against its under surface. The carry iron is in the form of a U-shaped bolt,  $3 \times \frac{3}{4}$  inches, in section

force is transmitted through the followers and springs to the inner key, which is prevented from moving inward by the ends of the slot in the draft plates. The back end of the slots are reinforced by steel pieces  $1\frac{1}{4}$  inches thick riveted on them as shown. When the draft gear is subjected to pulling strains the strain is transmitted through the outer key to the links, thence through the inner key to the back follower.

It will be seen that the design does away with all vertical bolts through the center fills, and that therefore the entire draft gear can be taken down without entering the car. This is a great advantage when repairs are to be made to loaded cars. The gear appears to be of ample strength. Mr. Tomlinson, in writing to us regarding it, says: "It may be adapted either to cars with one or two draft sills, or may be applied between sills without draft timbers, or to cars with steel or iron body framing. I have only applied it to three cars, for the reason that I wished to test it fully and beyond all question, and for a reasonable time. The test has extended for 13 months, and at the expiration of this time a careful examination shows that no repairs are necessary, and that in detail each part is in as good condition as when applied, so that I am now having the gear carefully gone over and parts redesigned to suit the various types of cars, and it is quite possible that the draft plates will be made of pressed steel, with follower guides formed integral therewith. The ease with which each individual part can be removed and replaced, the large factor of



### A Freight Draft Gear with Steel Draft Sills.

with ends  $\frac{1}{4}$  inch in diameter. This fits against the outside faces of the plates and has a piece of  $3 \times \frac{1}{4}$  inch steel riveted to it between the plates, this piece keeping the plates spread and also forming a bearing strip for the coupler shank. The drawbar stops are riveted onto the inner faces of the plates, and instead of a drawbar pocket or strap there are two keys  $4\frac{1}{2} \times 1$  inch in section united by links outside of the plates. One key passes through the drawbar shank in much the same manner as in the American continuous draft gear, and the other key passes through the plates behind the back follower and transmits pulling strains to the latter through the socket shown. This socket has a spindle which extends through the followers and spring to hold them in place.

When the draft spring is compressed by buffing strains the

strength we are able to obtain while maintaining great simplicity of construction, together with the absence of vertical draft bolts and of bolts and nuts in all removable parts, leads me to believe that we shall obtain very satisfactory results."

The gear was first designed for dump cars having one center sill, and was afterward adapted to cars having the usual two sills. The readiness with which it can be applied to single center sills is evident. The draft gear has been patented.

The builders' trial trip of the *Iowa* took place last month, and the vessel averaged 16.27 knots in a strong gale during a four hours' run, the engines developing about 11,000 horse-power at 112 revolutions. The contract speed is 16 knots.

## The Value of a Steam Jacket on a Locomotive.

The research committee of the Institution of Mechanical Engineers (England) have recently made a report on "The Value of the Steam Jacket," prepared by Prof. T. H. Beare and Mr. Bryan Donkin, in which is given the account of an experiment with jacketing the cylinders of a locomotive. The trials were undertaken and carried out on the Lancashire & Yorkshire Railway, at the suggestion of Mr. John A. F. Aspinall, Chief Mechanical Engineer, who gave every assistance to the experimenters. Owing to the fact that these trials were carried out on a locomotive doing its ordinary train service, it was impossible to obtain results as complete and thorough as would have been aimed at had the experimenters been able to make the trials on a special train, the working of which could have been arranged to meet the necessities of the experiment. The trials were of short duration and the condition of the fires at the start and the finish of each had to be determined by the necessities of the traffic requirements and could not therefore be varied to suit the wishes of the experimenters. The consumption of steam was obtained with a close approach to absolute accuracy; but the same cannot be said respecting the fuel consumption, owing to the above circumstance with regard to the condition of the fires. The results obtained are therefore not such as will enable any definite conclusions to be drawn as to the value of the steam jacket in locomotives. They are, nevertheless, interesting and valuable; and having involved considerable trouble on the part both of the experimenters during the trials and of Mr. Aspinall in the preparation of the engine for the experiment, it has been thought advisable to publish them for the use of the members. We present this condensation of the report to our readers:

"The experiment was made on a passenger locomotive, No. 1093, during its regular work of taking the 7:30 a. m. express train from Manchester to York, a distance of  $76\frac{1}{2}$  miles, and returning with the 3:00 p. m. express from York to Manchester. Both engine and tender are the ordinary standard pattern of this railway. The engine is a four-wheeled coupled with bogie truck, the driving wheels being 7 feet 1 inch diameter and the bogie wheels 3 feet 0  $\frac{1}{2}$  inch. The cylinders are inside and horizontal, with their valve chests on the top. The engine wheelbase is 21 feet 6  $\frac{1}{2}$  inches, and the total wheelbase of engine and tender 41 feet 1  $\frac{1}{2}$  inches. The weight of engine and tender when empty is 56,287 tons, and when in working order 80,925 tons, the tender carrying 1,800 gallons of water. The boiler is of steel, 4 feet 2 inches diameter and 10 feet 7  $\frac{3}{4}$  inches long; the firebox shell of steel, and the firebox of copper, 6 feet long, 4 feet 1 inch wide, and 5 feet 10 inches high. There are 220 tubes of 1  $\frac{1}{2}$  inches outside diameter. The heating surface in the tubes is 1,108.73 square feet, and in the firebox 107.68 square feet; total, 1,216.41 square feet. The fire-grate area is 18.75 square feet, the ratio of heating surface to grate area being 65 to 1. The fire-brick arch in the combustion chamber is about 2  $\frac{1}{2}$  feet long. The height of the chimney above the fire-grate level is 10 feet. The cylinders were originally of the normal pattern, 19 inches diameter and 26 inches stroke. For this experiment they had been bored out and fitted with cast-iron liners, which reduced the internal diameter to 17  $\frac{1}{2}$  inches, thus providing a body jacket of  $\frac{1}{2}$  inch space. The front cylinder covers were fitted with external covers, the space between the two forming a steam jacket. The back covers, however, were imperfectly jacketed by fitting over them, as close to the actual covers as possible, an annular wrought-iron ring with an inner and an outer cover, the space between the latter two forming a jacket space. The external surfaces of the end jackets were much exposed, and not well covered. A table accompanying the report shows the clearance volumes of the cylinders, and the jacketed and unjacketed internal surfaces exposed to steam in the clearances alone, and also in the clearances and cylinders at 90 per cent. of the stroke. It shows that the proportion of the clearance surface jacketed is only about a quarter of the whole, and this is mainly due to the cover jackets; of the back ends, therefore, a large part is hardly jacketed at all, in the true sense of the word.

"Four trials were made, A, B, C, D, on Sept. 18 and 19, 1894; A unjacketed and B jacketed on the 18th; C jacketed and D unjacketed on the 19th. A and C were made on the runs from Manchester to York and B and D on the return runs from York to Manchester. In each trial the weights of coal and feed-water consumed were measured, and readings of the various gages were taken, and the position of the reversing gear was noted. Indicator diagrams were obtained, and in trials C and D samples of the furnace gases were collected from the smokebox below the exhaust pipe. The coal used in the trials was from the Mitchell Main Colliery, Wombwell,

near Barnsley. Samples were taken from each sack used, and were submitted to Mr. Charles J. Wilson for determining the calorific value in a calorimeter. The mean value from his tests were 14,200 thermal units per pound of dry coal, equivalent to an evaporation of 14.7 pounds of water from and at 212 degrees Fahr. The actual coal consumption per indicated horse-power per hour of steaming time in the four journeys was, respectively, 2.87, 3.07, 2.73 and 2.79 pounds.

"On the first day no attempt was made to collect the gases; and as the thermometer for taking their temperature had been fixed above the blast-pipe orifice, it was not thought worth while to note its readings. On the second day the gases were collected continuously; but the thermometer, placed in a better position, unfortunately broke almost immediately after leaving Manchester, so that the temperatures could not be ascertained. The difficult operation of collecting the gases while going at express speed was carried out by Mr. Michael Longridge. During the outward journey C much trouble was experienced, owing to the heavy chimney-blast; but in the return journey D everything worked quite satisfactorily. The mean results of the three analyses made from the sample collected on each journey are the following volumetric percentages: Trial C carbonic acid, 12.85 per cent.; oxygen, 4.15; carbonic oxide, 0.80; nitrogen, 82.20. Trial D, carbonic acid, 15.10; oxygen, 1.97; carbonic oxide, 0.85; nitrogen, 82.08 per cent.

"As arranged by Mr. Aspinall, the feed-water was measured by means of a Siemens water meter on the pipe between the tender and the injector. The overflow from the injector was caught and allowed for.

"The jackets were drained into three small tanks carried upon a temporary staging on the front of the engine; one measurement was made for the two body jackets together; another for the two front covers, and a third for the two back covers. While standing at York on each day radiation tests were made, by measuring the quantity of steam condensed in each pair of jackets with the engine standing, all hot; these lasted 2  $\frac{1}{4}$  hours on the first day and 1  $\frac{1}{4}$  hours on the second. The following were the results obtained:

Condensation of Steam in Jackets, Pounds per Hour.

	While running.		While standing.	
	Sept. 1, B.	Sept. 19, C.	Sept. 18.	Sept. 19.
Two body jackets.....	267	241	35.0	26.7
Two front covers.....	123	103	16.0	13.7
Two back covers.....	65	55	12.0	12.8

"Indicator diagrams were taken simultaneously from both ends of each cylinder. The speed in miles per hour was continuously registered by a Boyer speed recorder, kindly lent by Mr. Aspinall.

"The mean results of all the important observations may be stated thus: Comparing trials A and C, both from Manchester to York, the jacketed trial C shows a consumption of 24.49 pounds of steam per indicated horse-power per hour, against 26.70 pounds for the non-jacketed run A, or a saving of 8.3 per cent. by jacketing. Comparing trials B and D, both from York to Manchester, the figures are 24.48 pounds and 24.87 pounds respectively, or a saving of 1.5 per cent. by jacketing. Comparing the figures for coal consumption in trials A and C, the jacketed trial C shows an economy of .14 pounds per horse-power per hour, or practically 5 per cent., the increased consumption per train mile in this run being accounted for by the greater load hauled; the load was 8 per cent. greater in C than in A, the average speed being nearly the same in both runs. Comparing trials B and D, however, the jacketed trial B is distinctly less economical, the coal consumption being .28 pounds greater per horse-power per hour than in the non-jacketed trial, or 10 per cent. more; and the consumption is also greater per train mile. In these two trials, while the weight of train hauled was the same, the speed was nearly three miles an hour greater in the non-jacketed run D, with a correspondingly much increased horse-power."

In spite of the rumors as to the condition of the equipment of the B. & O. Railroad, scarcely six per cent. of the cars and locomotives are in the shops for repairs. This is a wonderfully good showing, considering that the B. & O. has 875 locomotives and 32,000 cars, and traverses a very rough country. Much of the equipment that was in bad order at the beginning of last year has been thoroughly repaired and is again in service. All but 16 of the 75 new engines, which were ordered by the Receivers last spring, have been delivered and are giving eminent satisfaction.

The company is preparing to extend its compressed air plant at the Mt. Clare shops. A new locomotive repair shop is being built, and compressed air will be very extensively used. Two 50-ton cranes have been purchased for this shop, and the power will be electricity furnished by the power-station that also furnishes the electricity for the motors and Baltimore City tunnel.

Tests 1 and 2 represent a good muck-bar axle; tests 3, 4 and 5, a Western scrap axle, and tests 6, 7 and 8, an Eastern scrap axle. Tests 9 to 11 were made both with the steel in its natural state

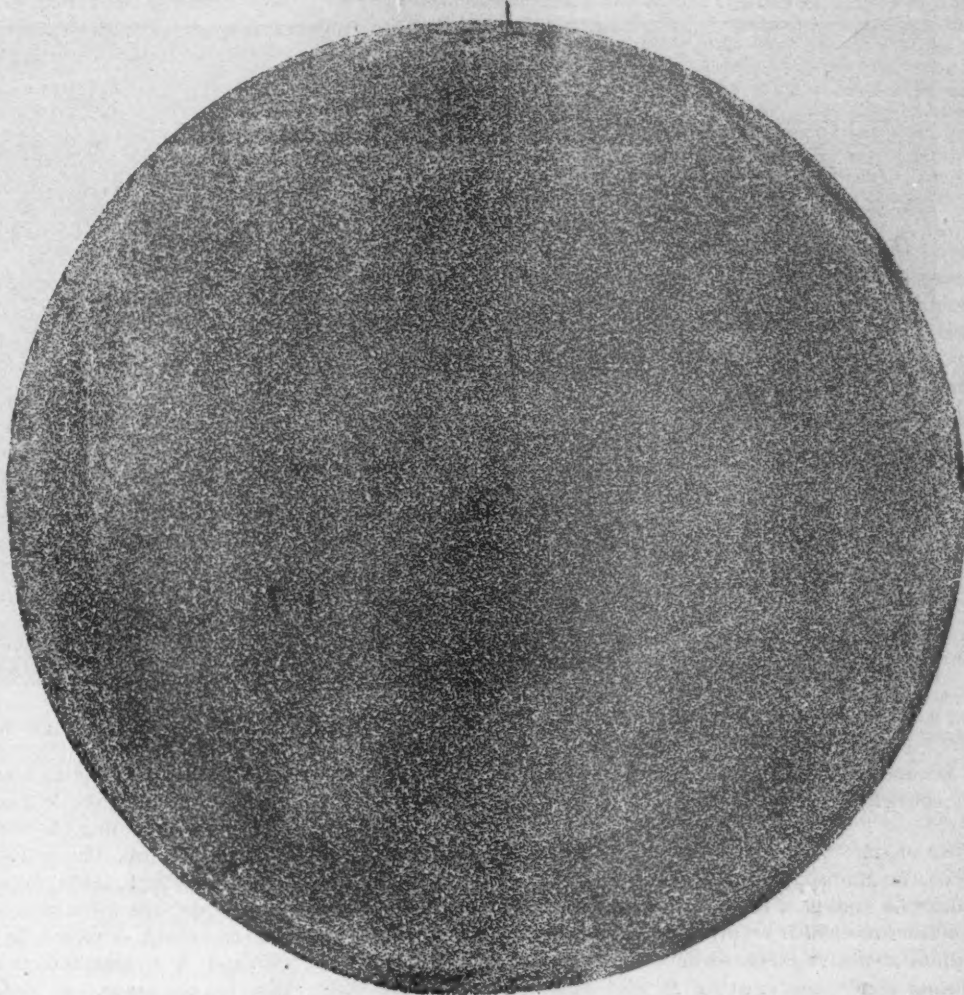
A comparison of the axles treated by the Coffin process with the steel axles untreated or with the iron axles is very much in favor of the Coffin process. For instance, the loss in weight of the open-hearth steel treated with the Coffin process averaged 10.3 per cent. (see diagram), while specimens from the

**Results of Abrasion Tests of Iron, Steel Untreated, and Steel Treated by the Coffin Process.—Cambria Iron Company's Laboratory, 1896.**

same axles untreated averaged 12.7 per cent., an increase of 23.3 per cent. expressed in terms of the lower figure. In the same way, if we average the three sets of iron axle tests (Eastern, Western and muck bar scrap), the loss is 21 per cent., or more than double the loss of the treated open-hearth steel.

These figures give a strong testimony to the value of the Coffin process of treating steel axles, cranks, pins, etc., which is fully borne out by the results from actual practice. In an article on annealing, by H. K. Landis, which recently appeared in the *Iron Age*, some statements are made on the general subject that incidentally substantiate the claims for the Coffin process, and are of interest in this connection. Mr. Landis says:

After casting, forging, rolling, or drawing, steel is more or less afflicted by contending tensile and compressive stresses, often local in character but always injurious. The cause of such local strains may be incomprehensible cores in castings, local forging, either hydraulic or by hammer, rolling at too low a temperature, cold wire or tube drawing, etc.; but whether frequent cracks or breaks appear or not, the fact that these do occur occasionally is sufficient evidence that strains incident to the process do exist. It is impossible to tell what strain there is in the interior of a shaft having larger sections forged upon it. . . . Yet we find very few among the host of iron workers in this country who adopt precautions to prevent accident by providing means for removing such strains. The remedy is simple and lies in heating the piece up to temperatures to be determined by subsequent treatment, ranging from 900 to 1,600 degs. F., and allowing them to cool more or less slowly. The high temperature allows the strains to adjust the particles of steel and produces a satisfied condition in the material, the rapidity of cooling afterward determining the final state or condition of the steel. The highest temperature reached determines the extent of the effect, whether



Etching of Open-Hearth Steel Axle Treated by the Coffin Process.

hardening or softening, while rapidity of cooling determines the quality possessed by the piece afterward. . . . If the idea is simply to remove strains in a piece, it may be heated to 1,000 degrees and cooled in the air, upon which it will be found to be tough. If greater toughness is wanted it may be cooled more rapidly, depending upon the quantity of carbon present in the steel."

The special treatment in the Coffin process is well calculated to give all the toughening effect indicated above and also to render the material dense and fine grained. We reproduce herewith the etchings of an iron axle and an open-hearth steel axle treated with the Coffin process. The photographic process is hardly adapted to the reproduction of the steel etching, as the minute, but important, changes which indicate the increasing fineness of structure near the circumference of the section are partly lost. Those of our readers who are sufficiently interested in the matter to write to the company can doubtless obtain impressions taken directly from the etched section.

#### Japanese Cruisers Contracted for in the United States.

During the past month the Japanese government placed contracts in this country for two armored cruisers, the *Cramps* of Philadelphia and the *Union Iron Works* of San Francisco each getting one to build. Each cruiser will be of about 5,700 tons displacement and will have a speed of 21 knots. The length on the water line will be about 330 feet; beam, 51 feet; draft, 20 feet; and the engines will develop 17,000 horse-power. The battery will consist of four 8-inch guns, eight 5-inch rapid-fire guns, twelve 6-pounders, four 1-pounders, and four Gatling guns. The boats must be completed in two years. The price is about \$1,250,000 each. Large contracts have also been placed in Europe by the Japanese government,



Section of Wrought-Iron Axle.



Locomotive for a Six Per Cent. Grade.—Pittsburgh, Cincinnati, Chicago & St. Louis Railway.

**A Locomotive Operating on a Six Per Cent. Grade—Pittsburgh, Cincinnati, Chicago & St. Louis Railway.**

The engine, which we here illustrate, was especially designed for use on Madison Hill, Ind., on the Louisville Division of the Southwest system of the Pennsylvania lines. For the photograph and description of it we are indebted to Mr. S. P. Bush, Superintendent of Motive Power, who was called upon to provide for the unusual conditions existing at that point. The peculiar conditions of the service at that place necessitated many departures from customary locomotive construction, and the proportions of the engine are consequently somewhat different from ordinary practice, and, in cylinder volume, it does not entirely conform to the rules recommended by the Master Mechanics' Association.

The grade upon which this engine has to wear away its existence, climbing and pushing with all the power its weight permits of, and then gliding down again without steam, is one of the steepest in the world upon which a regular passenger and freight service is maintained with the sole aid of adhesive power. The length of the grade is 7,012 feet and the total elevation is 413 feet, making a ratio of 311 feet per mile, or approximately a 5.9 per cent. rise.

When ascending this grade the cars, as a precaution in case of broken couplings, are pushed before the engine, and when descending the engine backs down preceding the cars. It is to be understood that the regular road engines are disconnected from their trains at the top of the grade, and left there waiting for the next train brought up by the hill engine.

In order to prevent the trains from gaining too much headway during the descent the engine is equipped with an interesting arrangement for regulating the speed. This device is based on the principle of the Chatelier brake, and is in some respects similar to that used on several of the Western mountain roads. It consists of connecting the valve chests with a 1½-inch pipe from which a 2-inch connection runs back to a point below the cab floor at the engineer's side where it terminates in a muffler. When descending the hill the link motion of the engine is reversed so that the cylinders during a portion of the stroke will force air up into the valve chests and from there through this pipe to the muffler, where it escapes into the atmosphere. By means of a regulating valve below the cab floor the escape of the air can be checked so as to obtain the desirable speed for the pistons and consequently for the engine. By closing the valve entirely the engine can be stopped during the descent.

In order to prevent the pistons sucking in air from the smoke-

box with accompanying cinders and grit, a steam jet is directed upward through the exhaust pipe from an opening in the hollow wall dividing the two exhaust passages. Fresh, clean air is admitted into the cylinders from a connection at the exhaust pipe base which leads to the outside of the smoke-box, and is shown over the valve chest in the illustration. This connection can be opened or closed by means of a valve operated from the cab, and it is apparent that it must be opened only when descending the grade. In order to lubricate the cylinders a small jet of hot water is let into each exhaust passage.

Besides this regulating device the engine is equipped with the American driver brake, and in addition a powerful screw hand brake, which alone will hold the engine and train on the grade.

As before stated, the service for which the engine was designed necessitated a departure from the customary proportions of locomotives. A road engine has to exercise its entire hauling capacity only when starting a train and getting up speed, but during the majority of the time only a fraction of the tractive power is needed. The total adhesive weight on the drivers is never utilized when the train is running at its regular speed with the lever hooked up toward the middle. It is then that the economy of expansion comes in. The exertion of the full adhesive power is not the exception but the normal condition of work on the Madison Hill. To use steam expansively under these conditions would be impossible, unless the cylinders were of much greater proportions, with regard to the adhesive weight, than on the ordinary road engine. The total weight of the new engine is 140,000 pounds, all adhesive weight, but the mean weight during the ascent is about 130,000 pounds, based on consuming two-thirds of the water in the side tanks. According to ordinary practice this weight would require a cylinder of about 22 inches by 24½ inches. The additional 8½ inches of the stroke which this engine has is a clear gain in the expansion of the steam, over and above that which may be produced when the engine does not exert its full adhesive power up to the slipping point. In other words, the cylinders were made as large as it was practical to make them, and the economy of this is shown by the fact that ordinarily the engine is able to make three round trips up and down the hill without refilling its coal bunker, which holds only a ton and a half of coal.

The engine was placed in service the first of the year, and has been giving entire satisfaction ever since. No official test of its hauling capacity has yet been made, although it is the intention to do so in the near future in order to obtain reliable data for

comparison and future use. It can be said now, however, that the engine has fully met the expectations of the officials, and its performance during the ascent, as well as the descent, is entirely satisfactory.

Quite a number of interesting details had to be considered in the design of the engine. In order to keep the front end of the top row of flues under water on the grade without filling the boiler so full as to cause the engine to throw water the back end of the boiler is set considerably higher than the front end. The throttle valve is of the ordinary balance type, but it has no play on its stem, the object being to avoid the clattering of the valve upon its seat in case the compression in the steam chest should exceed the boiler pressure during the descent. To protect the steam chests a relief valve has been placed on each, which is set just beyond boiler pressure. In arranging the driving springs for the engine it was calculated that the front springs would receive the greatest load and they were designed accordingly. When the engine is on the grade, however, its center of gravity is shifted backwards, and in consequence the rear springs receive the greatest load, which caused some little inconvenience at first.

Instead of metallic piston-rod packing, asbestos cord is used, as the metallic packing would be apt to be damaged when the engine is drifting down the hill without steam. The engine is equipped with a pneumatic bell ringer, pneumatic sand valves, steam heat for passenger trains, and all modern improvements.

The leading dimensions are as follows:

**No. 634—TANK LOCOMOTIVE, NON-COMPOUND, STANDARD GAGE.**

Fuel.....	Bituminous coal
Driving wheels, number.....	8
diameter.....	50 inches
Driving axle journals.....	8 inches by 8 1/2 inches
Wheel base (all rigid).....	15 feet 3 inches
Cylinders, diameter.....	22 inches
stroke.....	28 inches
spread of centers.....	7 feet 4 inches
Crosshead.....	Solid cast steel
Main rod, length between centers.....	9 feet 10 1/2 inches
Valve gear.....	Stephenson link motion, Richardson balance valve
steam ports.....	1 1/4 inches by 18 inches
exhaust ports.....	2 1/4 inches by 18 inches
outside lap.....	1 inch
inside lap.....	1 inch
valve travel.....	60 inches
lead.....	1/8 inch
Boiler: Inside diameter of barrel.....	5 feet
Thickness of sheet.....	7/16 inches
Height from rail to center.....	7 feet 6 inches
Steam pressure.....	150 pounds
Firebox.....	Belpaire
Length inside.....	7 feet 9 1/2 inches
Width " at bottom.....	3 feet 6 inches
Depth.....	4 feet 9 1/2 inches
Grate area.....	27 square feet
Tubes: Number.....	219
Diameter outside.....	2 inches
Length between tube sheets.....	13 feet 4 1/2 inches
Total area of tube sections.....	3.65 square feet
Heating surface, firebox.....	142.86 square feet
tubes, exterior.....	1,528.89 square feet
total.....	1,671.75 square feet
ratio to grate area.....	61.91 to 1
Exhaust nozzle, single, diameter.....	5 inches
Smoke stack, minimum diameter.....	18 inches
height from rail.....	15 feet
Capacity of tanks.....	2,000 gallons
Capacity of coal space.....	3,000 pounds
Tractive power, per pound, effective pressure on piston.....	271 pounds
total with 80 per cent. of boiler pressure.....	32,520 pounds
total adhesive, at 25 p. c. weight on drivers.....	35,000 pounds
Weight in working order.....	140,000 pounds

**More Engineer Officers Required in the Navy.**

The necessity of increasing the number of engineer officers in the navy is touched upon in the annual report of Commodore Melville, Engineer-in-Chief of the Bureau of Steam Engineering. He warns Congress, and incidentally the country at large, of the futility of building powerful warships without providing the necessary number of skilled officers to operate and maintain them. He says:

"I feel that it is only necessary to direct your attention to the number of engineer officers who have been retired during the past year for physical incapacity, and to the steadily increasing number of such officers on the retired list, to demonstrate that the physical strain to which the officers of the engineer corps are subjected is too great. In former annual reports I have given what I believe to be abundant reasons for an increase in the number of officers of the corps. As time goes on, and the number of ships and their power increase, the necessity for such an increase is intensified, and I feel that I would not be doing my duty if I did not again briefly refer to the matter.

"The personal element is one which must enter largely into the result of any naval engagement, and if we had the most powerful and the swiftest navy afloat it would be valueless to us in time of war if we had not a sufficient number of trained men to see that the machinery of this fleet is in condition for action and to keep it going in action. The guns will be powerless without the machinery, and, other things being equal, that fleet will give the best account of itself which has the best equipment of trained men in the engine-room, as well as at the guns. To sacrifice the one is merely inviting disaster to the whole, and no amount of skill on deck can compensate for the lack of it below."

It is to be hoped that Congress will take steps to correct this present weakness of the navy at its next session. The personal element is not made unduly prominent in the above statement, as any one who reads the past history of our own navy will readily appreciate. If the policy of this country is going to be the maintenance of a navy of only moderate size it is all the more important that every element tending to make it superbly efficient should receive attention. The most important naval matter now calling for consideration is the status of the engineer officers and the much-needed increase in their numbers.

**The June Conventions for 1897.**

The Master Car Builders' and Master Mechanics' associations will hold their annual conventions in 1897 at Old Point Comfort. The Hotel Chamberlin has been selected as headquarters, and the hotel rates will be the same as usual, namely:

	Without bath.	With bath.
Single room, 1 person.....	\$3 per day	\$4 per day
Double room, 1 person.....	4 "	5 "
Double room, 2 persons.....	3 "	4 "

The Hygeia Hotel, across the street from the Chamberlin, will make the same rates to members and their friends. At the Chamberlin rooms will be assigned only to members of the associations until March 1, after which application from others will be received. The Chamberlin is a new hotel of large dimensions and with excellent accommodations, and with the two hotels open there should be ample room for the great numbers who now attend these conventions annually.

**The Baltimore & Ohio Tunnel Plant.**

Within the next six weeks the three General Electric motors that have been used for the past year in hauling freight trains through the Baltimore City tunnel of the Baltimore & Ohio Railroad, will begin to handle the passenger trains in the same manner. The overhead trolley is being extended three-quarters of a mile north of the Mt. Royal station and about 1,500 feet at the south end of the tunnel. The motors are giving splendid satisfaction. The maximum load that has been hauled so far consisted of 41 loaded freight cars and two heavy locomotives. By the extension of the trolley line north and south of the tunnel entrances the helping engine will no longer be needed.

The new Mt. Royal station, at the northern end of the tunnel, is almost completed and it is a handsome and well-appointed passenger station. Attention has not only been paid to the architectural beauty, but the landscape gardener has given his best efforts toward beautifying the surrounding grounds. It is probable that the company will reconstruct its Camden station, at the other end of the tunnel, so that passenger trains will not have to back in and out, as has to be done at present. It is contemplated to erect new passenger sheds and necessary buildings near the mouth of the tunnel, by which the movements of trains between Washington and New York will be greatly accelerated.

The electric power plant is now being used not only to furnish the power for the tunnel motors, but to run 180 street cars of the Baltimore Traction Company, to light the Camden station and yards, the Baltimore City tunnel, the Locust Point freight-houses, warehouses and yards, Mt. Clare shops and the new Mt. Royal passenger station.

The four large engines generating electricity for power purposes are to be supplemented by a fifth engine. The foundations for it were laid long ago, and the installation of the engine is now

in progress. A 250 horse-power engine is also being added to the equipment devoted to lighting purposes.

A use for compressed air new to most of our readers is found in this plant. This is its utilization for forcing oil to the cups that lubricate the machinery. Tanks of oil are kept under about 60 pounds' pressure, and from these the oil is piped to the various bearings of the engines and dynamos. At the cups the pressure is about six pounds. The cups are always full of oil, and the rate of flow is adjusted in the usual way. The cylinder lubricators are not included in this compressed-air system, but cylinder oil is delivered under air pressure to a convenient faucet in the engine-room, where it is drawn off into cans for filling the lubricators. Westinghouse pumps maintain the air pressure.

The system installed by the movement of trains through the tunnel is, of course, very irregular at present, giving long intervals when no power is used. To meet this condition a low, smouldering fire is maintained under the boilers, and the machinery is kept at a standstill except when trains are being moved. The approach of each train is telegraphed to the power house, when the blowers are speeded up and steam is soon generated at a rapid rate and the engines and dynamos are started up to supply current for the moving of the train by the electric locomotive.

#### Electric Traction Under Steam-Railway Conditions.\*

BY DR. CHARLES E. EMERY.

In the light of recent achievements, it can be assumed at the outset that electric traction under steam-railway conditions is feasible. The only question is whether it will pay. The present applications only prove the former proposition, but do not touch the latter.

The greatest practical efficiency of an electric system of the kind proposed between the engines at the central station and the rails would probably be 60 per cent. This, on account of a second transmission to sub-stations and the necessity of using rheostatic regulation to some extent, would probably be reduced to 50 per cent., so that twice as many horse-power would need to be generated at the central station as at the track with the present steam locomotives. Each horse-power in the central station will be developed for two pounds of cheap coal or four pounds per net horse-power delivered, whereas the steam passenger locomotive will on the average require six pounds, based on net tractive force and allowing for the various wastes. The saving in coal due to electric passenger traction will, therefore, be one-third. Coal is procured cheaply by the railroads, but probably an inferior quality, costing 50 cents per ton, or, say, 25 per cent. less than that used on locomotives, could be employed in the electric stations, so that, for trains of like weight the saving in cost of coal for passenger service would be  $\frac{2}{3} \times \frac{1}{4} = \frac{1}{6}$ . For freight engines we calculate the saving in cost for fuel will be about 55 per cent., and for switching engines about 66 per cent. On railroads running through the coal regions the total cost is about 9 per cent. of the total operating expenses. A saving of one-half in the cost of the coal, then, corresponds to a saving of 5 per cent. of operating expenses. For reasons that will be stated later, it is believed that, for general railroad work, independent electric locomotives will be required, and that these will necessarily be as heavy as present steam locomotives, on which basis the only saving in weight will be that of the tender, which we have assumed as 10 per cent. of the total weight of the train for passenger engines, 3.3 per cent. for freight engines, and 5 per cent. for switching engines. The total load to be hauled will therefore be decreased by these several percentages, and the cost of coal reduced thereby to 45 per cent. of that required by the present locomotives for passenger trains; 43½ per cent. for freight trains and 32 per cent. for switching trains. Applying these percentages for the relative amounts of coal used for these different purposes on a prominent railroad, the average saving in fuel becomes 58.9 per cent., or 5.89 per cent. of operating expenses. The cost of water is taken at two-thirds of 1 per cent. on the same basis which increases the saving to 6.56 per cent.

Considerable saving has been claimed on other grounds. First, in relative repairs of electric motors compared with locomotives. Repairs will be less on the motors, of course, but they are not inconsiderable, and when we consider that the transmission line, trolley line and trolleys must be kept in repair as well as the motors, it

cannot be far in error to assume that the question of repairs will be about balanced, independent of central station apparatus otherwise provided for.

It has been claimed that labor will be saved, because the second man on an electric locomotive is required simply to provide for sickness or accident of the driver, and can well be the baggageman of a passenger train or the conductor of a freight train. Something of this kind may be worked out on an unimportant country road, but it would be impracticable on a large business scale.

It is also claimed that there will be a saving in the weight and cost of electric locomotives, particularly when applied under a car, but this system is of limited application. Heavy locomotives on trunk lines must have the same weight for electric as for steam traction, independent of the tender. Large savings in repairs to tracks and bridges are also claimed on account of the smoothness with which electric locomotives, having no reciprocating parts, would operate. The same weights must be run over the same rails at the same speed, and at least a great part of the wear and tear would be due to inequalities of the track surface, which would influence both systems alike. The present locomotives are so designed that, while the wheel loads on the drivers are heavy, the masses which strike blows are comparatively light; that is, they have simple wheels and axles, spring-connected to the frames. This is a very difficult thing to accomplish with an electric locomotive without using exactly the same construction. Each pair of wheels and attached motor acts as an enormous trip-hammer on the rails and roadbed the moment the former gets the least out of alignment. A connection to driving axles through gearing reduces the blows very materially, but introduces at high speed another difficulty. The vertical movements of the main axle would necessarily cause a change in the angular velocity of the armature during the time of such movement, which, for jars occurring in the fraction of a second would bring a heavy strain on the gearing and vary the speed of the armature momentarily. The variations in current due to such variation may also give a longitudinal pulsation to the train. The matter is not helped at all by mounting the motors on hollow axles concentric with the driving axles, so that the motors may be spring-supported from the axles, for in such case the connection of the motor to the axles must be through links the equivalent of a universal joint, which produce variations in velocity, when the axles are out of center with the armature, similar to those where gearing is employed.

For reasons above given, it will be necessary to mount electric motors for fast locomotives away from the centers of the axles and connect through side rods, as in the present locomotives. There is another important reason for this. In order to obtain speed, the motors must be wound for it so that the counter-electro-motive force will be produced by velocity rather than the number of turns, and, in starting, the motors are necessarily connected in series so as to reduce the starting current. For motors adapted to very high speeds, it will be necessary to put pairs in series even to surmount heavy grades, to act as pushers in case of accident, or in removing snow, etc. The counter-electro-motive-force is therefore divided between several motors, but not necessarily in equal degree. If, with motors connected to separate axles, one for any reason slips its wheels, it will monopolize the larger portion of the electromotive force and cut down the current on all the motors in series, so that full power cannot be obtained. Working the motors in parallel with an enormous rheostat would be wasteful, and, in some cases, impracticable. It is, therefore, important for two reasons to connect driving wheels operated by separate motors by means of side rods.

Again, it is essential, that, on the road, speed be regulated by better means than a rheostat. A series motor varies its speed with the load and so cannot run without rheostatic regulation at a given speed if for any reason the number of cars in the train or the track resistance varies. It will, therefore, be necessary to return to commuted series field coils or equivalents, and it will be perhaps desirable to have a shunt winding which can be used to give still closer regulation. In fact, shunt motors are being introduced abroad for traction purposes. The use of these devices will increase the weight of the motors compared with simple series-wound motors. These considerations make more room desirable for the motors than can be provided in the trucks of an ordinary car.

For these several reasons it is predicted that the high-speed electric locomotive of the future will, like the steam locomotive, be a structure independent of the train, that the motors will be hung on the frame independent of the driving wheels, and the same as

\* From a paper presented at the meeting of the American Institute of Electrical Engineers, New York, Oct. 21, and Chicago, Oct. 23, 1896.

well as the driving wheels connected by side rods. To obtain proper room under such conditions larger driving wheels will be employed than the wheels of an ordinary car. This will so extend the wheel base that it will not be safe to run at high speeds without the leading truck, the same as on an ordinary locomotive, and, in fact, the electric locomotive will in all its general features be a steam locomotive without the boiler, with motors substituted for the steam cylinders. In this way and probably in no other can the flexibility of the present steam locomotive be obtained. Again, it is desirable that the whole locomotive be a unit, on a strong frame, calculated to resist the shocks due to collisions and accidents, and it is doubtful if locomotive drivers will be found who will be willing to risk their lives on any other kind of a structure.

To realize the flexibility of the ordinary locomotive one has but to go on the line of one of the roads which has not yet adopted the heaviest type of rail, but yet runs express trains at 45 miles per hour, grasp a convenient post close to the line and a little around a curve, if possible, where one can take the wind of the train, and watch its approach. In many cases the locomotive sways nearly a foot from the perpendicular, first one way and then the other. At a bad joint the plunge is so rapid that the effect can be described as terrific, as one cannot but think of the consequences if such a mass should leave the rails. The locomotive, however, follows the inequalities as readily as would a farm wagon. Electrical engineers may insist upon a more rigid and better track, but this will require additional expense and will not entirely overcome the difficulty. The electric locomotive must be constructed so that it will do the work of the present locomotive in the same way, and the feature of flexibility cannot be sacrificed.

A modern heavy locomotive costs about \$10,000, which is at the rate of \$10 to \$12 per horse-power, on about the same basis as electric motors would be rated. It needs little argument to show that an electric locomotive, to take its place under conditions stated, would cost fully as much. Moreover, if like care is to be taken of electric locomotives as of those for steam, the same number must be employed of like capacity for like work.

An approximate calculation of the cost of electrically equipping and operating a trunk line has been based on information in regard to the operating expenses of different railroads, given in the series of articles by Mr. Baxter, in *The Electrical Engineer* early this year. We have adopted his facts, and for convenience have used some of his methods, but have been obliged to entirely disagree with his conclusions. For instance, we calculate that the cost of the steam and electric generating plants will be about three times as much as he states, the transmission plant and sub-stations about twice as much, and the operating expenses about  $5\frac{1}{2}$  times as much as he provides for. Necessarily the conclusions are diametrically opposite.

The calculations are based on the operating expenses of a railway system comprising nearly 2,700 miles of road, and employing 1,800 locomotives. By calculations based on the train miles, checked by the reported coal burned, and the probable number of engines in use, we estimate it will require 280,000 horse-power in the stations, on the basis of 50 per cent. efficiency from stationary engine pistons to track, and if 60 per cent. can be obtained by commutated fields, or other means herein discussed, the difference simply provides for an expected increase of travel. From the probable average power and the actual reported operating expenses corresponding thereto, we proceed as follows: For facility of calculation and to obtain an underestimate, rather than one too large, the power required for the switching engines is distributed among the regular trains on the road. It is also assumed that the average number of trains is continued the entire length of the road, instead of using a much greater number than the average for suburban travel. These methods cause an underestimate of the cost of the electric transmission, but enable the cost of operation to be accurately worked up from the averages. The latter is the more important point, as the other merely involves comparatively small questions of difference in the amount of interest.

By this generalization the trains will be assumed as separated about  $7\frac{1}{2}$  miles, independent of direction, over the whole length of the road for every hour in the year. On this basis there will be required on the average 106 station horse-power per mile of road, independent of direction of trains, but to provide for concentrations which will inevitably occur, the generating plants and transmission lines have been worked out on the basis of 150 horse-power per mile. The assumed number of trains will require on the average about 400 horse-power each at track, or 800 at station. To obtain the economy due to fairly large stations they are assumed to be separated 45 miles from each other, and at two intermediate points transform-

ers and rotary converters (transformers) located, by which means the feeders are supplied every 15 miles. On the above basis it is assumed that 6,750 horse-power is installed at each steam station, and 2,250 horse-power at each sub-station.

To avoid overestimates the cost per horse-power of steam and electric plant in main stations has been assumed as only \$80 per horse-power with \$20,000 for buildings, and for the whole apparatus in the sub-stations there has been allowed only \$10 per horse-power and \$10,200 for buildings and the copper in the high-tension lines. The low-tension copper has been worked out on the basis that half-way between the main and sub-station two trains may meet, each requiring 1,000 horse power, and that a uniform section of copper sufficient to carry  $7\frac{1}{2}$  miles, the current required for half of this power, at an original tension of 700 volts and a drop of 20 per cent., would be ample for the whole length of the low-tension lines. On this basis the cost of copper at this basis the cost for copper at 13 cents per pound for the outgoing low-tension conductors will be \$12,386 per mile. It is assumed that provision for supporting the outgoing conductors and the bonds in main track for return current will cost \$5,000 per mile.

On the basis of these prices, without considering incidentals, the total cost of the electrical generating and transmission plant foots up \$31,057 per mile, the annual interest on which, at 5 per cent., is \$1,553 per mile. If the services of the 1,800 steam locomotives can be furnished by 1,500 new electric locomotives at \$10,000 each, the same will cost \$5,556 per mile, requiring \$278 annual interest per mile, making the total interest on steam and electrical plants, including locomotives, \$1,831 per mile. The operating expenses of the station, considered as a steam station only, from Emery's tables, reduced to 24 hours and 365 days, modifying cost of plant and eliminating coal and interest, is found to be \$25.84 per average horse-power per year. The time of 12 extra men for care of electric apparatus in the main and two sub-stations amounts to \$2.75 per horse-power per year, which makes the total operating expenses of the generating, transmission and locomotive plants, exclusive of coal and interest, \$28.59 per average main station horse-power per year, or \$3,031 per mile, or, with interest added, viz., \$1,831, as above, a total of \$4,862 per mile. The operating expenses of the station thus calculated include an allowance for repairs, insurance, taxes and renewals.

It should be recollected that the cost of coal has been already provided for in the percentage of saving first developed, and that the train expenses are assumed to be the same as for steam locomotives. The operating expenses of the road using steam amounted to \$15,187 per mile. Of this, as previously stated, 6.56 per cent. will be saved by the use of electricity, corresponding to \$996 per mile. This subtracted from \$4,862 per mile (given as the cost of operating expenses of the generating stations, etc., with interest added), leaves \$3,866 per mile per year as the additional expense which will be entailed by the application of electricity as a substitute for steam; so, on the basis that the operating expenses are 50 per cent. of the gross receipts, such gross receipts must be increased 12½ per cent. by the introduction of electricity over the whole length of the line, in order to enable the road to pay the same dividends as before.

It may be considered that the results will be changed materially by the use of high-tension transmission throughout. If tri-phase currents at a tension of 10,000 volts were received by each electrical locomotive, the tension reduced by transformers carried by the locomotive, and current employed to operate induction motors directly, or to operate direct current motors through rotary converters also carried by the locomotives, the saving independent of extra transformers and converters would amount to \$9,714 per mile, corresponding to \$486 interest per mile, and reduce the total increased operating expenses to \$3,380 per mile, which would require that the gross receipts be increased 10.2 per cent. in order to pay the same dividend as before, instead of 12½ per cent., for combined high and low tension transmission. The saving in dollars is quite large, but the total costs are so enormous that the saving makes but a small difference in percentage. It will similarly be seen that differences in kind of apparatus employed will have very little difference on the general results, though the savings are important in themselves.

It must be recollected that these results are based on providing electric traction for the whole length of a trunk line. It can hardly be expected that the gross receipts for the whole line will be increased, say one-eighth, by such an application. If, however, the application be made within the radius of suburban traffic such an increase is not only probable, but it may be expected that the cost of operation per passenger mile will be reduced in greater proportion than stated, so that the application of electric traction will pay

from the outset. These considerations will apply to longer distances on railroads like the New York, New Haven & Hartford, where the passenger business furnishes the larger proportion of the income.

Again, it is possible to accomplish with the electric locomotive results that are impossible with the steam locomotive. The power for the former being generated originally in stationary boilers, or in some localities derived from waterfalls, is not limited, and the power of the motor can be increased indefinitely, so that in particular locations a demand either for greater power to obtain more speed, or a greater or more continued tractive force than is now possible with a steam locomotive, can be met by electricity without difficulty.

On the whole, therefore, although the application to the whole length of trunk lines does not seem practicable under present conditions, there is no doubt but that the industry will grow in the future as certainly as in the past.

### Communications.

#### Water-Spray Firing.

EDITOR AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL:

I notice that the discussion of Professor Goss' experiments has, among other new (?) things, brought out the fact that a small amount of water introduced into the flame of coal fire in a spray improves the fire, *i. e.*, increases its heat. The daily practice of every country blacksmith for the last 100 years has proved it. The experience of every active member of any fire department is to the effect that the first few streams thrown on a blaze acts almost like so much powder, especially if in a frame building or a pile of lumber.

R. ANGST,

Chief Engineer, Duluth & Iron Range Railroad.

[The point which was especially brought out in the discussion referred to was not that the admixture of a small amount of moisture with a fire was new, but that it was beneficial in a steam boiler, a fact which is certainly not well established or generally known. If our correspondent knows of the actual use of water-spray in firing a boiler of any kind, it would be very interesting to know the particulars.—EDITOR AMERICAN ENGINEER.]

#### Fire-Resisting Qualities of Graphite Paint.

EDITOR AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL:

In your issue of November we note an article on "Graphite Paint for Metal Work." There are so many good qualities about graphite paint, when properly made, that we think it extremely unwise to exaggerate such qualities. In the face of the testimony which you mention, there would seem to be no contradiction possible to the statement that "a fire in the neighboring flour sheds played upon ironwork, painted with graphite paint, for two and a half hours without blistering the paint," and yet we cannot help but think that there is a mistake somewhere in this statement.

Over 25 years ago, the Joseph Dixon Crucible Company, Jersey City, N. J., had its attention called to the virtues of graphite paint, by its mine superintendent, who had for the past 10 to 15 years been making graphite paint and using it on roofs of various kinds in the neighborhood of Ticonderoga, N. Y. It was shown conclusively that roofs properly painted did not require repainting in 10 to 15 years. Furthermore, that as graphite was about three times the bulk of lead, and about twice the bulk of mineral paints, it had correspondingly that much more covering power, and that for economy, as well as for durability, it seemed to be the proper paint to use for protecting roofs, whether of metal, wood or canvas. Believing that graphite paint would be a fitting addition to the company's graphite products, the Dixon Company began the manufacture of graphite paint, uniting with it a certain proportion of silica, and putting it on the market under the title of silica-graphite paint.

During the years since the company began the manufacture of this paint, tests of almost every conceivable character have been made with the paint, but we must confess that we have never yet made a paint that would successfully stand the fire test mentioned above.

There is no question of the fire-proof qualities of graphite, but there must necessarily be some binder to hold the graphite to the painted surfaces. Various oils have been tried, and various other vehicles, and although we have called in the services of many chemists, and even the expert of the National Oil Company, we have yet to find any organic substance in the way of oil or a vehicle that will successfully withstand high degrees of heat, and as we have above said, there are so many good qualities in a graphite paint properly made, that we regret to see any statements made that seem to be exaggerated and which, if tested by an interested party, may cause more or less prejudice against a paint that is destined to be hereafter recognized as a best preservative and protective paint for all kinds of work, exposed to the various agencies so destructive to paint.

Permit us also to say that, during the past two to three years, various graphite paints have made their appearance on the market that lack the essential qualities of perfect graphite paint. There are graphite paints that are made of ordinary plumbago foundry facings; there are even graphite paints that are made of simply mineral paint, colored with lamp black. To such an extent are these paints now made, that it will be well for the public to know just what the article is before orders are placed.

JOS. DIXON CRUCIBLE COMPANY.

NEW JERSEY, Nov. 23, 1896.

#### The Needs of Our Navy.

EDITOR AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL:

Since the launching of the *Indiana*, the first of our 10,300-ton first-class battleships, in February, 1893 (this ship was commissioned during the last of November, 1895), the British Admiralty has designed, constructed, tried and placed in commission the two first battleships of the *Majestic* class, of 14,900 tons displacement. And not only this, but the 12-inch guns forming their main battery are of entirely new design and exceedingly powerful; in fact, they are more than equal to the 13-inch U. S. Naval guns in power, and weigh 16 tons less. The 6-inch and 3-inch (12-pounder) quick-firers, also, and the mounts for all the guns on board are of new design, and all the guns from the largest to the smallest, use smokeless powder, a satisfactory variety of which, called "cordite," from its form, having been secured long ago.

By the time that our two new battleships of the *Kearsarge* class are completed, even though it takes only three years, the British Navy will have been reinforced by all the ships of the *Majestic* class; one or two type ships of a new class of battleship will have been pushed forward to completion and more will be under construction, and three or four dozen cruisers, many of them of high speed and power, fully armed, will have been added to their gigantic navy.

France has under construction some thirty-four ships, and Russia is not so very far behind France, for, taking into consideration the new battleships just commenced, she has almost double the number of armored ships building. Italy, in spite of her poverty, has eight armor-clads building and they are being completed more rapidly than any of her previously constructed ships, and Germany has four and Spain five armored ships building.

During the time that the new United States ships are under construction it would seem probable that Great Britain can safely be counted on to complete 12 ships of the battleship class, France five or six and a couple of armored cruisers, and Russia twice as many battleships and armored cruisers as France, as she has a large number of armor-clads completing afloat, besides those on the stocks.

Following the example set by Great Britain in working nights by the use of the electric light, in completing the *Magnificent*, she is pushing the completion of some of her ships by night as well as by day, and it is hoped that the new ships recently laid down will be completed in two years by following this system.

Naval construction seems to be the fad of the age as far as nations are concerned, and the Argentine Republic, with its 4,000,000 inhabitants, has to-day laid up at its naval station on the Tigre River more first-class torpedo boats than the United States will possess when all those building and authorized are completed, and she is having built in Great Britain six "destroyers" of the same type as the Russian *Sokol*, an improvement on the British *Havock* class of boats, both of which you have described.

When Ex-Secretary Tracey, some years ago, told us what position the United States Navy would occupy among the navies of the world, when all the ships authorized were completed, it is evident

that he did not take into consideration the increase that would take place in all the other great navies, and the increased rapidity of construction the world over. Nothing is plainer to a person who reviews the present condition of the United States Navy, and compares it with the other navies, than that it is entirely inadequate to the present needs of the country.

If we are ever to have a navy at all in keeping with our probable needs, and are not going to try and construct one in an emergency, at great cost, and then probably make a failure of it, it is surely time that we set about its construction in sober earnest, following some well-devised plan formed with a definite object in view.

And now, what of all our experiments with wire-wound guns, of which we heard so much at one time? The new Woolwich (British government) 12-inch guns are wire-wound and steel-jacketed. The new Elswick (Armstrong) 12-inch, 8-inch and 6-inch guns are wire-wound and steel-jacketed. British, Japanese, Italian, Argentine and Chilean ships are being armed with these guns.

The new Woolwich 12-inch guns give a muzzle energy of 33,940 foot-tons, and a perforation of 38.5 inches in wrought iron. Our 13-inch guns, with their 16 tons more weight, have 33,827 foot-tons of muzzle energy, and perforate 34.6 inches. The Elswick 12-inch guns for Japan are even more powerful, as they are five calibers longer. Both these guns, it is said, can easily be loaded and fired twice while our 13-inch guns are being loaded and fired once. Some comparison might be made between our 8-inch and 6-inch guns and those of Woolwich and Elswick, and with the same general result.

Now, right here is an illustration of what smokeless powder will do, for a good smokeless powder will make the 40 caliber U. S. guns practically the equals of the 40-caliber Elswick guns just mentioned, as far as perforating power is concerned, but it won't alter the breech action of the United States guns making them into quick-firers capable of firing five shots in two minutes, instead of two shots in three minutes. The Elswick people claim four shots a minute for their new 8-inch gun with the light (210 pound) projectiles!

For some time past we have been turning out new ships with 4-inch and 5-inch guns of the quick-firing type, not using smokeless-powder charges (a grave defect), but with their 6-inch and larger guns of the ordinary pattern of breech-loaders; while Great Britain, France and Italy, to say nothing of the smaller powers who purchase guns of Armstrong, Krupp and Caulet, have been re-arming their older ships with quick-firing guns of as large caliber as 6.3 inches and converting their old breech-loaders, including those of 6.3-inch caliber, into quick firers.

Give the *Chicago*, *Baltimore* and such ships new batteries of quick-firing guns and their offensive power is immediately increased four or five fold, at least. The new battleships of the *Indiana* class are simply ridiculously weak in moderate caliber gun-fire, with only four 6-inch breech-loading guns, but give them four 6-inch quick-firers in place of them, and their moderate caliber gun-fire is immediately increased, as in the case of the other ships, four or five fold. All this being so, and I think that no well-informed person disputes it, I would ask, why are we so slow in developing 6-inch and 8-inch quick-firing guns and placing them on our ships?

In ignoring the development of private ordnance factories, and confining the construction of all naval guns excepting the small quick-firing and machine guns to the Washington Ordnance factory, have we adopted the best means of keeping in the front rank with our naval ordnance, or developing our resources, ready for an emergency? And is it not fully time for our ordnance experts to be up and moving in a determined manner to join the van?

W. V. B.

The Christmas Number of *Harper's Magazine* will contain part third of "The Martian," with six illustrations from the author's drawings. An entertaining article on "President Kruger" will be contributed by Poultney Bigelow, and Dr. William Jacques will describe the process of obtaining electricity direct from coal. W. D. Howells will give personal recollections of the Autocrat of the Breakfast Table in the article entitled "Oliver Wendell Holmes." Two well-illustrated papers will be those entitled "Wild Ducks and Tame Decoys," by Hamblen Sears, and "How the Law got into the Chaparral," by Frederic Remington. In "a Middle English Nativity," John Corbin will describe miracle-plays performed by strolling actors, in which the English drama had its beginning. There will be six short stories, a "Christmas Carol," etc. The number will be bound in an ornamental cover especially designed in colors by Howard Pyle.

### The Operating Mechanism of the New Rock Island Bridge.

The new bridge over the Mississippi River, between Rock Island, Ill., and Davenport, Ia., recently opened for traffic, is a notable structure and has attracted much attention from engineers. It is the third bridge to span the river at this point in the last 40 years. The first bridge on this site was completed in 1856 and was the first bridge over the Mississippi River, and it is interesting to note that in litigation which subsequently arose from the opposition of the "river interest," Abraham Lincoln appeared as counsel for the railroad company.

In 1866 and 1867, Congress passed acts authorizing the constructing of a new bridge and the removal of the old one. The Phoenix Bridge Company was given the contract for the superstructure and in 1872 the bridge was opened for traffic. This bridge was strengthened in 1891 to meet the requirements of the increased traffic and in 1894 an entirely new superstructure and partly new masonry were authorized, and the necessary appropriation made by Congress for the construction. Mr. Ralph Modjeski was appointed Chief Engineer, tenders for the work were received on Aug. 12, 1895, at Rock Island Arsenal, by Col. A. R. Buffington commanding, and the contract subsequently awarded to the Phoenix Bridge Company.

The new bridge has two shore spans of 196 feet 6 inches and 101 feet respectively, five fixed river spans of 256 feet 6½ inches, 220 feet 1 inch, 219 feet 10½ inches, 220 feet 1½ inches, and 260 feet 4½ inches, and one draw span of 386 feet 9½ inches, making a total length of 1,841 feet 3½ inches. It is double-decked, the upper deck carrying two railroad tracks and the lower deck being devoted to a roadway with two street-car tracks between the trusses and two walks for foot passengers outside the trusses. The trusses are 29 feet centers and the total width over the side-walks is 45 feet. The trusses are calculated to carry a total moving load of 11,360 pounds per lineal foot, of which 8,000 pounds are on the railway floor and 3,360 pounds on the roadway floor. The solid corrugated steel railway floor, together with the guard angles and rail plates, weigh about 940 pounds per lineal foot of the bridge. The draw span, which weighs approximately 2,500,000 pounds, is one of the heaviest ever built.

The operating machinery of the draw was furnished by Geo. P. Nichols & Bro., Chicago, and is of unusual construction. It may be considered under four different headings.

#### THE SWINGING MACHINERY PROPER.

The rack attached to the tread on the center pier instead of having teeth of the usual form is made of steel with sprockets. On each side of the drum is a vertical shaft, supported by brackets, on the lower end on which are cast-steel sprocket wheels corresponding in pitch with that of the rack, which is 12 inches. These sprocket wheels carry an endless chain with links of 12 inches pitch that engage the sprockets on the rack. On the upper end of these two vertical shafts are other sprocket wheels connected by chain to vertical driving shafts which rise up to the floor of the machinery-room. An interesting feature of this part of the construction is the fact that all these vertical shafts are run on ball step bearings. On the upper end of these main vertical shafts and on a level with the machinery room floor are gears, one looking up the other looking down, the two being connected through pinions with a horizontal cross-shaft divided in the center, where an equalizing gear is attached. By means of a train of of gears a 50 horse-power electric motor is connected with the shaft, thereby transmitting the power from the motor to the rack on the masonry.

#### RAIL LOCKS.

On the ends of the railway track on the draw is a system of rail locks consisting of heavy steel slides fitted to the outside of each rail and held in position by guides so that they may be run out or be withdrawn. When in the locked position they connect the ends of the rails on the draw with those on the fixed span, so that the wheels of the train will pass over the intervening gap on these latches, thereby eliminating any jar, as a continuous track is presented to the wheels. These latches are set and withdrawn by means of a pneumatic cylinder near each end of the

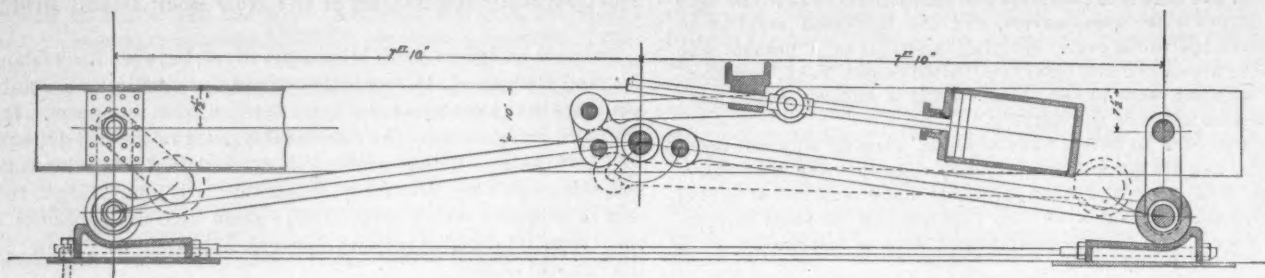


Diagram of End Jack Mechanism of the Rock Island Bridge.

draw, each connecting by a system of rods to all four latches at its end of the draw. The two cylinders are controlled simultaneously.

#### THE END JACKS.

The jacks themselves are the semi-toggle type consisting of two pairs of bars attached to each end of the end beams directly under the corners of the bridge. These are connected with the end beams by pins, while on the lower end are rollers which bear on bearing plates on the abutments. By means of a pneumatic cylinder and connecting struts these jacks are forced to a vertical position when the bridge is closed and are drawn in so

locked, is released. The movement of this latter lever unlocks the motor controller lever, which now being free can be moved for operating the bridge. This system makes it impossible for the operator to swing the bridge until first the rail lock and then the end jacks have been released, the indicator above referred to announcing to the operator that these various devices have gone through their movements. Inside the machinery-house is a compressor driven by an electric motor and in the attic above the machinery-room are two steel reservoirs of a combined capacity of 200 cubic feet, from which air is drawn to operate the various devices referred to. A uniform pressure of 120 pounds is maintained automatically by the pump.

The electric current for swinging the bridge is furnished from the power station of the Tri City Railway Company, whose wires pass directly over a support on the bridge, also from the People's Power Company, of Moline, whose wires are brought up to the same support on the bridge. By means of a system of rings and brushes current is taken over these wires and brought up to the switchboard in the machinery-room, where a double throw-switch is placed so that the motor may be connected either with the railway wires or those of the People's Power Company.

#### Compressed Air in Shops.

In the last month three valuable papers on compressed air have come to our desk. One of these was presented by Mr. J.

Davis Barnett, of the Grand Trunk Railway, to the Canadian Society of Civil Engineers; another valuable contribution to the literature on the subject is the paper by Mr. Curtis W. Shields before the New York Railroad Club; and the third paper was presented to the Western Railway Club by Mr. J. H. McConnell, of the Union Pacific. We regret that the demands on our space this month do not admit of a full synopsis of these papers; as it is, we will refer briefly to them, and our readers who want complete copies can obtain them from the secretaries of the societies mentioned.

Mr. Barnett goes into the subject at considerable length. On the question of efficiency he says:

The author does not intend to say that air, for continuous work in plate flanging, or for high pressures in stamping and forging, is a more economical transmitter of power than water, or that pipes, air engines and motors are better or cheaper than wires and electric motors, or independent air-driven tools than steam applied through shafting and belts to a compact group of machine tools, but he is of the opinion that if many widely scattered, different and intermittent operations are to be performed; if a cold climate has to be fought; if the technical skill and knowledge of the workman employed is limited; and if the special and portable tools are more or less of home design and manufacture to suit the particular and limiting conditions of their use, then air has efficiency, economy and a wide field of usefulness.

After discussing various types of compressors he has the following to say about storage and pipes:

The shop piping or main for ordinary pressures (80 to 100 pounds,



The New Rock Island Bridge.

as to release the bridge when it is to be opened. The principle of the construction is shown in the diagram given herewith.

#### THE INTERLOCKING AND CONTROLLING SYSTEM.

A Hall signal is placed on each of the fixed spans within a few feet of the ends of the draw which nominally stand at danger. Connected to each of the jacks and rail locks are electric switch boxes from which wires run to an indicator in the machinery-room. When any one or all of the jacks or rail locks are in a closed position a red lamp is lighted in the indicator, one lamp for each jack or lock, and when they are released for the bridge to swing a white lamp is lighted, replacing the red. By a combination of electric connections, the man in charge of the draw can set the signal to safety only when the heavy jack and locks are set. Thus, if for any reason the bridge is not properly locked the engineer cannot receive his signal to enter upon the draw.

#### CONTROLLING DEVICE.

In the front end of the machinery-room, in a bay window from which the operator can see the tracks and the river, is placed a controller consisting of four levers. The first one to the right operates a band brake applied to the machinery. The second lever controls the rail locks and can be moved at will. This being thrown forward, the lever controlling the end jacks, previously

should not be less than  $1\frac{1}{4}$  inches diameter, the larger the better. The author having 4-inch pipe to spare on hand, used it with great satisfaction, as it gave ample storage and little friction. Very slight provision is required for drainage. The main is best carried on the top of the roof tie-beam, and from the first should be liberally supplied with short branches and outlet valves, at least one to every 18 or 20 feet, with screwed ends to fit the union nuts of the flexible hose, the hose for hand tools and hoists varying from  $\frac{1}{2}$  to  $\frac{3}{4}$  inch diameter. Cords from the outlet valve lever run down to within seven feet of the floor, controlling the position of the valve. Reservoir storage has to be proportionately, the larger the more intermittent the work done. The pipes and reservoir together should be capable of holding the total delivery of the compressor (working at normal speed) for half an hour, which is far cheaper than providing an excessively large size compressor, cheaper not only in first cost but in daily working. This refers to steam-power compressors.

Mr. Barnett then shows how great is the saving in labor by the use of compressed-air appliances, and proceeds to discuss rotary and reciprocating piston motors. He considers that while the use of rotary motors has been stimulated by the introduction of air, little advance has been made in their design. They are wasteful of air, but their convenience retains them in use. He uses portable double acting vertical engines, with cylinders  $3\frac{1}{4}$  by 6 inches, running at 225 revolutions. He reheats the air as follows:

Just before it enters the valve chest, it is passed through a 30-inch length of thin copper pipe,  $\frac{1}{2}$  inch outside diameter, bent into a four-turn truncated coil, barely  $3\frac{1}{4}$  inches diameter at base and  $2\frac{1}{4}$  inches diameter at top, contained in a tin lamp 12 inches long, by  $3\frac{1}{4}$  inches diameter at bottom and  $1\frac{1}{4}$  inches diameter at top. The lamp cistern carries a double "B" burner, using two  $\frac{1}{2}$ -inch flat wicks, and burns an imperial pint of common coal oil each 30 hours. No glass chimney is required, and the flames come close to inside of coil. This lamp it bolted on close to and parallel with the cylinder, and is cheap, neat and inconspicuous, working satisfactorily, even when the engine is set at an angle of 15 or 20 degrees out of vertical.

The paper by Mr. Shields is devoted largely to a consideration of the economical compression of air. The losses due to heating during compression, to clearance in the cylinders, and to friction in the compressor are all discussed at length, and the methods by which these losses are reduced to a minimum in the modern first-class compressor are pointed out. Diagrams of isothermal and adiabatic compression are given, also curves of volumes, pressures and temperatures; tables of temperatures and heat losses in compression carried to various pressures; tables of air used in motors per indicated horse power, and much other valuable data of a similar character. Various authorities are quoted on the cost of compressing air, reheating and other features of good practice. The cost of 1,000 cubic feet of free air compressed to 100 pounds (gauge pressure) is given as 5 cents, including all charges and with coal at \$4 per ton. Reheating is considered of great importance where motors are used continuously for any length of time, and a horse power at the reheater can be obtained for one-eighth the fuel required for a horse power at the compressor. The advantages of multiple-stage compression are elucidated, and the paper closes with a quotation from the practice of Mr. McConnell, in the Union Pacific shops, showing the saving per day in labor at various points in the shops where air is used.

Mr. McConnell's paper comes to us just as we go to press, and in terse language gives many valuable hints on the application of air. Lifts, jacks, drills, staybolt cutters, and many other devices are mentioned; also the use of air for driving emery wheels, for blowing out cylinder passages, for moving locomotives between the erecting shop and roundhouse by charging their boilers with air, for driving scrap shears, for stamping in the tin shops, for the blast of portable forges, for operating portable engines, for raising sand in the sand-houses, for kindling locomotive fires, for the blast for fires in the blacksmith shop, etc., etc. These are all touched on and enough said about them to show how the applications can be made by those who desire to extend the use of air in their own shops.

The *Street Railway Review* of Chicago will on January 1, 1897, begin the publication of a foreign edition which for the present will appear quarterly. The interest now manifested in other countries in the use of electricity for street railway work is the immediate occasion for this step, as it is believed that the development of that industry in the United States, and the experience gained here, should prove valuable abroad, and should predispose managers and engineers to favor American methods, systems and special devices. This is a reasonable expectation, and we wish our contemporary success in its new venture, and American manufacturers an influx of foreign orders as a result of it.

### Powerful Compound Locomotives for the Northern Pacific Railway.

The Schenectady Locomotive Works are building for the Northern Pacific Railway Company four Mastodon or 12-wheel compound locomotives, which will be the most powerful engines of this type ever constructed.

The engines are of the Schenectady two-cylinder compound type, the high-pressure cylinder being 23 inches and the low-pressure 34 inches in diameter, with a stroke of 30 inches. The cylinders are fitted with the new intercepting valve, designed by the Schenectady Locomotive Works, which enables the engine to be operated as simple or compound at will, this device now being in very successful use.

The weight of the engine will be about 180,000 pounds, with 148,000 pounds on drivers. The driving-wheel centers are of cast steel, 48 inches in diameter, which with  $3\frac{1}{4}$ -inch tires makes the diameter of drivers 55 inches.

The boiler is of the extended wagon-top type, 72 inches in diameter at the front end, has a larger heating surface than ever used in locomotive practice, and is built to carry a working pressure of 200 pounds.

### Discipline Without Suspension.

In an excellent paper on discipline Mr. H. S. Mitchell, Division Superintendent of the Kansas City, Fort Scott & Memphis Railway says that when discipline without suspension was first tried on his road he was doubtful of the efficacy of the system in dealing with men who take no pride in their work. He found afterward that it was just this class of men on whom the discipline had the greatest effect. He says: "But how about the man who is generally careless, who does not take pride in his work? It was on this very point that I was doubtful myself, and when the circular to Memphis employees announcing the change of discipline was being prepared, I urged the insertion of the following clause: 'Suspensions will be imposed when the head of the department deems disciplining by marks unsuitable to the case or to the individual.' But with the experience I have since had, I am perfectly willing to surrender this reservation, believing now that suspensions are not necessary to effect proper discipline among, even second-rate men. In fact it is this class that seem to take the matter most seriously, evidently looking upon it as a scheme of their superiors to get rid of them. They, of course, regarded suspension as an undesirable thing, but entertained the idea that, having undergone a suspension, they were thereby purged of all guilt and entitled to a fresh start. They now realize that while they escape suspensions, the offenses that were formerly punished in that way are treasured against them, and that eventually each offence, treated so indulgently at the time of its commission, will contribute in a measure to causing their dismissal. They discover that trivial offenses, never considered sufficient to warrant suspension, are now recorded and are liable to prove the straw that breaks the camel's back. Perhaps in no other particular is the advantage of the new system so pronounced as in the matter of disciplining for small irregularities, and as a result we observe a marked decrease in the number of slight, but vexatious, blunders. Another desirable feature is the opportunity afforded an officer to reverse or amend his ruling in particular cases, if, after the lapse of time, he finds that he has erred, or that evidence not obtainable at the time of the original investigation places the matter in a different light."

One of the elevators in the American Tract Society's 23-story building in New York City, one day last month dropped 140 feet at a speed just too slow to throw the safety clutches into action. The elevators are on the high-pressure system and have given considerable trouble. They have a total lift of 267 feet 7 inches, and a speed of 700 feet per minute. The trouble with the high-pressure system is said to be that the small volume of water required for the work makes fine regulation very difficult and the new valves designed for the system have not worked as well as expected. The immediate cause of the accident was the blowing out of packing by which the water was allowed to rush out of the cylinder. The elevators are to be altered over to the low-pressure system.

(Established 1832.)

# AMERICAN ENGINEER

## CAR BUILDER AND RAILROAD JOURNAL

27TH YEAR.

65TH YEAR.

PUBLISHED MONTHLY

BY  
R. M. VAN ARSDALE,

MORSE BUILDING.....NEW YORK.

M. N. FORNEY,  
W. H. MARSHALL, } Editors.

R. G. CHASE, 705 Western Union Building, Chicago.

DECEMBER, 1896.

Subscription.—\$2.00 a year for the United States and Canada; \$2.50 a year to Foreign Countries embraced in the Universal Postal Union.

## EDITORIAL ANNOUNCEMENTS.

**Advertisements.**—Nothing will be inserted in this journal for pay, EXCEPT IN THE ADVERTISING PAGES. The reading pages will contain only such matter as we consider of interest to our readers.

**Special Notice.**—As the AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 25th day of each month.

**Contributions.**—Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.

**To Subscribers.**—The AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.

The paper may be obtained and subscriptions for it sent to the following agencies: Chicago, Post Office News Co., 217 Dearborn Street. London, Eng., Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane, E. C.

## CONTENTS.

ILLUSTRATED ARTICLES:	Page.	MISCELLANEOUS:	Page.
A New Freight Draft Gear.....	320	Electric Traction Under Steam	328
Abrasion Tests of Iron and Steel	322	Railway Conditions.....	328
Cambria Iron Co.....	322	Water Spray Firing.....	328
Locomotive for a Six Per Cent.	324	Fire-Resisting Qualities of Gr-	328
Grade—P. C. C. & St. L. Ry. ..	324	phite Paint.....	328
The Operating Machinery of the	329	The Needs of Our Navy.....	328
Rock Island Bridge.....	329	Compressed Air in Shops.....	330
Construction and Maintenance of	335	Powerful Locomotives for the	331
Railway Car Equipment.....	335	Northern Pacific Road.....	331
Locomotives Recently Con-	339	Discipline Without Suspension..	331
structed by the Baldwin Loco-	339	Personals.....	335
motive Works.....	339	Citizenship and Technical Edu-	345
Grate for Burning Fine Anthra-	343	cation.....	345
cite—D. L. & W. Ry.....	343	Explosive Properties of Acety-	344
The Most Advantageous Dimen-	347	lene.....	344
sions for Locomotive Exhaust	347	Corosion of Metal Tender Frames	344
Pipes and Smoke Stacks.....	347	Electricity as Applied to Trac-	344
The Q. & C. Pressed Steel Brake-	353	tion.....	344
shoe Key.....	353	New Publications.....	346
EDITORIALS:		Cost of Repairs to Electric Street	346
Cast Iron vs. Steel-Tired Wheels	332	Cars.....	346
The Movement for the Adoption	332	Trials of the Pneumatic Machin-	346
of a Standard Freight Car.....	332	ery on the U. S. Monitor Ter-	346
Defects and Improvements in	333	ror.....	346
Locomotives.....	333	Arbitration Committee Deci-	347
Prospects for Electricity on	334	sions.....	347
Steam Roads.....	334	The Situation in China and	351
MISCELLANEOUS:		Japan.....	351
The Altoona Shops of the Penn-	317	The Society of Mechanical En-	351
sylvanian Road.....	317	gineers.....	351
The Value of a Steam Jacket on	321	Association of Ry. Supt. Bridges	351
a Locomotive.....	321	& Bldgs.....	351
More Engineer Officers Required	325	Trade Catalogues.....	352
in the Navy.....	325	Equipment Notes.....	352
The June Conventions for 1897..	325	The Roberts Water-Tube Boiler.	353
The Baltimore & Ohio Tunnel	325	Manufacturing Notes.....	353
Plant.....	325	Our Directory.....	354

There appeared in our columns last month an abstract of a comparison between steel-tired and cast-iron wheels, presented recently to the Southern and Southwestern Railway Club. By that comparison the steel-tired wheel was shown to be much less economical than its competitor. There is no doubt that for many kinds of service the cast-iron wheel is the cheaper of the two, but it is a question if the difference is always as great as the figures given in the comparison referred to would indicate. To make a comparison upon the mileages guaranteed the respective wheels is not so accurate a method as if the actual average mileages are taken, unless it can be shown that the guaranteed and actual mileages bear the same ratio to each other. There are those who believe that the actual mileages of the steel-tired wheels exceed their guarantees to a greater degree than do cast-iron wheels. There is also the number of wheels discarded because of flat spots or other defects to be considered, and which does not seem to have been taken into account in the paper mentioned. The question of safety is also an important one, and while the high-grade cast-iron wheel is a product that does credit to the foundryman, and is remarkable for its freedom from fracture in service, there are positions in which railroad men are loath to trust it. In heavy fast passenger service the coaches will be found to be carried upon steel-tired wheels, even if the cast-iron wheels are used under other coaches on the same road. The truck wheels of fast passenger engines are steel tired. Freight engines may have cast-iron truck wheels when the leading trucks have four wheels, but if the engine is of the Mogul type a steel-tired wheel is often substituted. Other cases might be cited, but these are sufficient to show that reliable as is the cast-iron wheel when properly made, the steel-tired wheel is considered preferable under conditions that are unusually severe. We are of the opinion that if accurate statistics on the safety and service of the two types are collected for various classes of service, instead of lumping them all together, the results will show that railroads have good reason to use steel-tired wheels in some classes of service, and that there is a wide field of usefulness for both types of wheels.

An important movement having for its purpose the establishment of standard 60,000-pound box car, into which shall be incorporated all the Master Car Builders' standards and recommended practices, has been inaugurated by the Ohio Falls Car Manufacturing Company, of Jeffersonville, Ind. That company does not expect that this movement will change the standards of large systems, but it may be instrumental in bringing about a uniformity in the freight car equipment that is hereafter to be required by smaller roads and private companies, who wholly or in part accept the specifications of the builder. Such a result is well worthy the hearty co-operation of every railroad company and of Master Car Builders and foremen, as every shop must repair these cars, and they should welcome any progress toward simplifying their present diversity. The other car building firms throughout the country have been invited to join in the movement and to signify their preferences in the following dimensions of the proposed standard: Length, width and height, in the clear inside; door opening; center to center of body bolsters; section of each sill, end sill and plate; height of lining; diameter and ends of truss rods; wheel spread; section and set of each arch and tie bar; diameter of column and oil box bolts.

The originators of this plan believe that this movement will result in creating a uniformity among the contract car works, primarily of the parts mentioned, and later of many of the less essential parts, as well as of the details of fruit, coal, stock and flat cars. The standard can be kept up to date by incorporating all standards as successively adopted or recommended by the Master Car Builders' Association or by the united judgment of the manufacturers. The plan is to be commended, and we think it would be a fortunate thing for the railroads of this country if it should ultimately result in a standard design in which each and every detail is included and which would be followed by more than the small roads. The large roads should be interested in this movement by reason of the prospective reduction of the

diversity that now exists; and if the movement succeeds their passive interest may turn to an active one and they may be induced to join it. They have frequently been urged to take steps themselves toward the adoption of a standard car, but as yet have failed to do so. In fact, they have never seriously entertained the matter, and so we have in the country a million and a quarter of cars of thousands of different designs, few of them confined to any one locality, and some of nearly every design, ultimately passing through every repair shop in the land. There is no necessity for so many designs, particularly in the cars that are extensively interchanged, and if wisely designed standard cars are once thoroughly established their adoption ought to extend rapidly. The movement inaugurated by the Ohio Falls Car Manufacturing Company is deserving of hearty support.

#### DEFECTS AND IMPROVEMENTS IN LOCOMOTIVES.

##### III.

In our September number this subject was partially discussed with an announcement that its consideration would be resumed in a future number. The sources of waste which were then pointed out were imperfect combustion, due in part to bad firing; defects in grates and small fireboxes, and to the excessive temperature of the escaping chimney gases and the heat in the exhaust steam. The remedies which were then suggested were the improvement of firemen, larger fireboxes and grates, variable grates in which the live and dead portions could be varied at pleasure and devices which would bring about a more intimate contact of air with the fuel to be burned, feed-water heaters and steam superheaters. Down-draft grates were also proposed as worthy of investigation.

The great deficiency in most of our large locomotives of the present day is in the size of their fireboxes. With our bar frames 3 or 4 inches wide, if the firebox is placed between the frames, the width of the grate cannot exceed about 35½ inches. If the firebox is placed above the frames the grate may be about 8 inches wider, but the depth over it must be considerably reduced. The Wooten type of firebox, which is placed entirely above the driving wheels, can then be made as wide as the widest part of the engine, but it must then be very much reduced in depth. This is in a measure compensated for, in some cases, by making it long and using a bridge wall and thus forming a combustion chamber at the front end. Still the fact remains that the fire, in this kind of firebox, and in less degree in the so-called "toboggan" form, which is above the frames, is brought comparatively near to the crown-sheet. Now, in any fire, but especially one which is burned as rapidly as that in a locomotive grate is, it is very important that the process of combustion should be as near completed as possible before the flame or gases come in contact with the heating surfaces. Such contact undoubtedly partially arrests combustion. Plenty of room in the firebox, especially above the grate, is, therefore, regarded as a matter of much importance, and as promotive of good combustion.

Twenty-five or thirty years ago the standard passenger engine in this country weighed about 30 tons, and had about 15 square feet of grate and about 800 square feet of heating surface. Now our passenger engines, many of them, are of double that weight, and have twice that amount of grate and heating surface, and the average speed of trains has been increased about 50 per cent. and their weight doubled. To haul twice the weight at a given speed will require double as much steam and at a speed 50 per cent. greater, the train resistance will be increased about one-third. Now, if the old 30-ton engines burned 24 pounds of coal per minute to haul their trains at 30 miles per hour, the big engines should burn twice as much, or 48 pounds, to haul a train of double the weight. If, besides, the speed is increased 50 per cent., the quantity of steam consumed in a given time would be in the same proportion, which would require a consumption of coal of 72 pounds per minute, and as the train resistance would then be one-third greater at the increased speed, we would have a total consumption of 96 pounds of coal per minute. That is, with double the grate and heating surface, we must burn four times the quantity of coal

in a given time that the old engines did. The figures are, of course, only assumptions and are used merely as illustrations, but they will explain, what has often been remarked, that our modern locomotives do not do the amount of work in proportion to their size that the old engines did "before the war." In other words, the locomotives of to-day are deficient in boiler capacity. Now, how can the boiler capacity be increased? Obviously the limitations are those of space and weight. We are confined in width and length and height, and the weight which can be carried on each wheel must not exceed a certain amount. The problem is a very old one, and the ingenuity of designers of locomotives has been exercised on it ever since the latter have outgrown their limitations. The plan, which seems to be a solution of the difficulty—at least in the case of passenger engines—is that embodied in the "Columbia" type of engine, in which the driving-wheels are all placed in front of the fire-box and the overhanging weight of the latter is carried on a pair of small trailing wheels. By depressing the frames back of the driving-wheels and carrying them below the firebox, it can be made of a reasonable depth or height, and of any width desired. But if the wheels are large, say 7 feet diameter, even if they are placed as close together as is practicable, the boiler, if arranged as in ordinary locomotives, must be very long and the tubes will be about 15 feet in length, unless the front tube sheet is set back farther than is customary. While long tubes would have the advantage that they would facilitate the use of the method of heating feed-water, which was described in our preceding article, and would give considerably more heating surface, their greater length and that of the boiler would increase its weight very materially. The problem, then, is how to reduce the weight either of the boiler or other parts of the locomotive so that its total weight will not exceed the limits to which it must of necessity be confined?

We are thus confronted with very much the same problem which Ross Winans wrestled with in the early days of the Baltimore & Ohio Railroad, when he first began to build eight-wheeled coupled engines for that road, which had very sharp curves and heavy grades. His "camel" engines had wheels 48 inches in diameter, and a total wheel base of 11 feet 2½ inches. All the axles run in front of the firebox, the outside width of which was just sufficient to allow its front end to go between the back pair of wheels. The boiler had 103 tubes, 2½-inch tubes 14 feet 1½ inches long. The grate was 7 feet long by about 43 inches wide. The weight of engine with water and coal is given at 24 tons; whether long or short ones does not appear in the records available. The diameter of boiler was 46 inches. The heating surface in the tubes was 903 square feet, and in the firebox 86½, or a total of 989½ square feet. With that size of boiler and weight of engine, it will be seen that it was not an easy problem to keep the weight down to the limitations to which they were then confined. The top of the firebox was therefore made to slope downward from the point where it joined the waist of the boiler to the back, and the top was made flat and stayed with ordinary stay-bolts. It is doubtful whether any locomotive boiler of equal capacity was ever made which weighed so little. Unfortunately its weight is not now known. It is true that many of them exploded, but that was probably owing to the deficient staying at the base of the dome, which was very large, and located just back of the front tube-sheet. This same form of firebox was afterward adopted and is still extensively used in the Pennsylvania Railroad, although no new engines with boilers of that form are now built. It has given excellent service, and by those who have had the best opportunities of learning and knowing, the writer was recently told that there was no boiler on the road which weighs and costs so little, in proportion to its capacity or is so economical to maintain or has given better service than this. Some of them were originally made too small, which was not a defect in their form, but in their proportions. There can be no doubt that a very material saving in weight can be effected by using this form of boiler.

There is another consideration which has not a sufficient amount of attention in locomotive designing, which is, that for every

pound of weight saved in the other parts of the machine, a pound may be added to that of the boiler. The substitution of steel and wrought-iron parts for those heretofore made of cast iron has made a very great economy in this direction possible, and it seems certain that if a skillful designer should carefully go over every part of any ordinary locomotive and remove all unnecessary material that a very considerable reduction would be possible, without any diminution in strength, and possibly by some intelligent design in some cases an increase in strength. The use of cast-steel wheel centers reduces their weight some hundreds of pounds, and if some genius would devise a method of counterbalancing the pistons, cross-heads, etc., without the use of counterweights, several thousands of pounds more of useless weight could be dispensed with.

An essential requirement in locomotives of to-day is larger fire-boxes and greater boiler capacity. The plan of placing the driving wheels all ahead of the fire-box, and carrying it on a pair of trailing wheels, enables the fire-box to be increased in width without material diminution in depth. The old discarded and discredited, but nevertheless efficient, form of fire-box described, will permit of a very material diminution in weight over any other form in use. There is also the consideration that the nearer an apartment approximates in plan to a square the smaller will the walls be for a given enclosed area. Thus supposing we have a grate 4 by 12 feet the length of the enclosing walls would be 32 feet and the enclosed area 48 square feet. If the grate was 8 by 8 feet the enclosing walls would have the same length, but the area would be 64 square feet instead of 48. The enclosing walls of a fire-box which is nearly square, will, therefore, weigh less for a given grate area than they would if the grate is long and narrow. This same principle applies with reference to the cubical contents of a fire-box—an important matter. The nearer it conforms to a cube, that is, the nearer the length, breadth and height are alike, the lighter will be the enclosing walls in proportion to its cubical contents.

Of course, if it was practicable to make a fire-box spherical in form, it would be the lightest possible shape that could be adopted. It will be seen, then, that the "Columbia" plan of engine not only permits the fire-box to be enlarged laterally and vertically, but it may at the same time be made lighter for a given area of grate. By adopting the Winans' or camel fire-box, with the "Columbia" type of engine, the weight which overhangs behind the driving axles could be lightened, or, conversely, its size may be increased without adding to its weight. The purpose of this article, then, is to call attention to the advantages which are inherent in the "Columbia" plan of engine and the camel fire-box or something similar to it.

The subject of this article will be taken up again in a future number.

#### THE PROSPECTS FOR ELECTRICITY ON STEAM ROADS.

In discussing last month the immediate prospects for electricity on steam roads we referred to the paper on the subject which had been presented before the electrical engineers in October and the discussion which took place thereon. Mr. Emery, in his paper published elsewhere in this issue, says that the use of electricity for long-distance traffic is feasible, and the real question is whether it will pay. He shows that in city and suburban traffic electricity is an established success and one feature of it is the increased travel which has been created by it. In long-distance traffic he holds there is little probability of increasing the amount of travel and that electricity must compete with steam on the basis of the same amount of business for both. He further believes that the electric locomotive for high speeds will eventually resemble the steam locomotive more than it does now. In his opinion it will be advisable to mount the motor separately and gear it to a shaft from which the power will be transmitted to the driving wheels by connecting and parallel rods. The leading truck he also believes will be needed to give flexibility and security at high speeds.

So much for the conditions of the problem and the tendencies in electric-locomotive construction. He then proceeds to com-

pare the actual figures for an Eastern trunk line with a possible electric installation to handle the same traffic. The first item of importance in many of the discussions on this subject is the saving in fuel, but he shows that on the steam road the fuel bill is only 10 per cent. of the total expenses and that, therefore, if one-half of it was saved the actual reduction of expenses would be only 5 per cent. As an actual fact this saving will be swallowed up by fixed charges and an additional traffic of from 10 to 124 per cent. will be needed to wholly meet these charges.

In the discussion which followed, these figures were not challenged, but there appeared to linger in the minds of several prominent electricians the hope that if electricity did not pay in dollars and cents in such traffic it might ultimately succeed because of other advantages accruing from its use, such as increased power and greater speed than is possible with the steam locomotive, and the possibility of more successfully operating traffic in small units. Now, much as one may desire to see electricity a success in long-distance traffic, nothing is to be gained by glossing over facts, which is what is done by those who present such arguments.

Take the question of the weight of trains. The tendency toward heavier train loads is one of the characteristics of the progress being made toward cheaper transportation on steam roads to-day, and it is based on sound principles. As Mr. Emery shows, the fuel consumption is but about ten per cent. of the operating expenses, and experience shows that heavier trains in general reduce the other operating expenses, such as wages, etc., more than they increase the fuel consumption. Instead of undertaking the long-distance traffic with reduced train loads, the electrician should in most cases be prepared to haul heavier trains than at present. The strenuous efforts now being made by railway managers to get more tonnage in each car and more cars in each train is a fact the significance of which should not be overlooked.

As to the increase of speed possible with the electric motor, it is of questionable utility. Increased speed always means increased cost, and there seems to be no reason why this should not apply equally to electricity and steam. On this assumption, it is reasonable to suppose that the increased speed is not wanted for freight service, and if wanted can be obtained with steam as readily as electricity. In passenger service the steam locomotive can attain any reasonable speed, and the enormous velocities claimed to be possible with electricity would call for such large expenditures for brakes, signals, etc., as to render the speeds impracticable, particularly if the slow-moving freight trains are to be operated on the same line.

Nor does the claim for greater power in the electric motor seem well founded. If the weight of the locomotive can be increased, greater power can be obtained with steam. Unless it can be shown that for a given weight the electric locomotive can develop more power than its competitor, the greater power is not available. The experience thus far gained would seem to indicate that instead of weighing less, the electric motor will weigh more when it carries all the accessories that are necessary for economical operation.

It is matter of regret that any prominent electricians can be found who are ready to defend such an unmechanical affair as the Heilmann locomotive, or to express the belief that some good may come from the experiments with it, as was done in the discussion referred to. The motive power at the head of a train is fairly satisfactory when it consists of a boiler and a steam engine, and it may be a success when it is made to consist of an electric motor, but when it carries all of these and dynamos in addition it is doomed to failure.

The conclusion seems inevitable that electric motive power, to be successful in long-distance travel, must be superior to steam in dollars and cents, and must haul trains of the present, or heavier, weights on existing schedules.

The idea that compressed air mixed with steam in the cylinder of a steam engine would be productive of economy has been endorsed in times past by engineers of eminence. Some ground for

this belief exists in the known fact that the presence of the air in the steam decreases the amount of cylinder condensation. To find the exact effect of such a mixture upon the economy of an engine tests were recently undertaken at Stevens Institute (and published in the *Stevens Indicator*), the engine used for the purpose having a single cylinder  $7\frac{1}{2}$  inches in diameter and 14 inches stroke, running from 200 to 228 revolutions per minute and cutting off at one-quarter of the stroke. The tests were in four series, as follows: 1st, Tests 1 and 1A, using steam alone; 2d, Tests 2, 2A, 3 and 4, using air and steam, the air at a temperature of 70 degrees; 3d, Tests 5, 6 and 7, using steam and air, the air being heated to about 540 degrees Fahr., corresponding to the temperature of adiabatic compression; 4th, Tests 8 and 9, under the same conditions as 5, 6 and 7, except that the air orifice was enlarged to twice its original diameter. The steam-pressure averaged about 90 pounds. In series 2 and 3 the air entered the steam-pipe through a hole  $\frac{1}{16}$  inch in diameter and in series 4 the orifice was  $\frac{1}{2}$  of an inch. The air admitted varied from  $1\frac{1}{2}$  per cent. (by weight) of the steam to  $8\frac{1}{2}$  per cent. The indicated horse-power averaged about 20. The water per indicated horse-power, without air, averaged 33 pounds. When air was used it averaged 30.7 pounds. The best results gave a saving of about 7 per cent., but this is almost exactly offset by the power required to compress the air, so that the saving per net horse-power is nil.

### Personals.

Mr. H. T. Woods has been elected General Manager of the Tabor & Northern Railway.

Mr. W. W. Noble has been appointed Purchasing Agent of the Huntington & Broad Top Railway, vice Mr. S. B. Knight, resigned.

Mr. Joseph S. Harris has been chosen President and Mr. William R. Taylor Secretary of the reorganized Philadelphia & Reading Company.

Mr. George Hafer has retired from the presidency of the Cincinnati, Lebanon & Northern, and is succeeded by Mr. Joseph Wood, of the Pennsylvania lines.

Mr. George C. Gorham, of Washington, for many years Secretary of the United States Senate, has been elected a Vice-President of the Northern Pacific Railroad.

Mr. W. W. Tomlinson has been appointed Chief Engineer of the New Orleans & Western, with headquarters at New Orleans, La., to succeed Mr. C. B. Deason, resigned.

Mr. J. T. Odell has resigned as Second Vice-President of the New England Railroad, so that he can devote all his time to the Butler & Pittsburgh, of which he is President.

Mr. Wm. H. Stocks has been appointed Division Master Mechanic of the East Iowa Division of the Chicago, Rock Island & Pacific Railway, with headquarters at Rock Island.

Mr. Volney T. Malott, of Indianapolis, Ind., has been appointed Receiver of the Vandalia system. Mr. Malott is Chairman of the Board of Directors of the Chicago & Western Indiana.

Mr. B. A. Denmark, of Savannah, has been elected President of the Southwestern Railway, to succeed the late President Baxter. Mr. Denmark has been a Director of the Central of Georgia.

The Marietta & North Georgia road has been reorganized as the Atlanta, Knoxville & Northern, and Henry K. McHarg has been elected President, Mr. Eugene C. Spaulding, Vice-President, with headquarters at Atlanta, and Mr. Joseph McWilliams, General Manager, with headquarters in the same city.

Mr. John M. Egan has been elected Vice-President of the Central Railroad of Georgia and will have his headquarters at Savannah, Ga. Mr. Egan has occupied many important railroad positions with ability, among them the Presidency of the Chicago Great Western, and in that position he was the Agent of the General Managers' Association at Chicago during the Debs strike.

Mr. George F. Ely, Secretary and Treasurer of the Cleveland City Forge and Iron Company, died suddenly on Oct. 28. Mr. Ely began his business career in the office of his father, who at that time was Treasurer of the Lake Shore road. In 1864 he entered the firm of Coe, Ely & Harman, which in 1871 was incorporated as the Cleveland City Forge and Iron Company. At the time of his death he was also interested in several other manufacturing interests.

The promotion of Mr. Atterbury from Fort Wayne, to be Superintendent of Motive Power at Altoona has led to several other changes in the Mechanical Department of the Pennsylvania system. Mr. Bernard Fitzpatrick, Master Mechanic of the Pennsylvania lines at Columbus, O., has been appointed Master Mechanic at Fort Wayne, Ind., to succeed Mr. Atterbury; Mr. Thomas F. Butler, Master Mechanic, at Wellsville, O., has been transferred to Columbus, O., to succeed Mr. Fitzpatrick; Mr. George P. Sweeley, Master Mechanic at Crestline, O., has been transferred to Wellsville, O., and Mr. P. F. Smith, Jr., Assistant Master Mechanic, of the Fort Wayne shops, has been appointed Master Mechanic at Crestline, O., to succeed Mr. G. P. Sweeley.

Gen. Joseph T. Torrence, well known in railroad circles through his connection with the Chicago & Western Indiana road and through the part he took in track elevation in Chicago, died in Chicago, Oct. 31, in the fifty-fourth year of his age. He was born in Mercer County, Pennsylvania, and was early thrown on his own resources. He was working as foreman in the Briar Hill iron furnaces at the opening of the war, which position he resigned to enlist in the army. After his return from the war he took charge of iron furnaces in Pennsylvania and in 1869 went to Chicago as Manager of what is now the Union Works of the Illinois Steel Company. From that time on he was interested in many iron plants in the vicinity of Chicago. He also in the early eighties took the presidency of the Chicago & Western Indiana and helped to build up that line. He was also one of the promoters of the Chicago & Calumet Terminal Railway. In recent years his magnificent scheme to construct an immense elevated terminal system for all the roads entering Chicago from the south brought him more prominently before the public than ever. His terminal plans were not realized, but much of the credit for the work of track elevation since accomplished in that city is due to the energy with which he grappled with the problem.

### CONSTRUCTION AND MAINTENANCE OF RAILWAY CAR EQUIPMENT.—IX.

BY OSCAR ANTZ.

(Continued from page 254.)

FREIGHT TRUCKS—CONTINUED.

In Fig. 53 is shown a diamond truck which differs in a number of points from those described in the previous articles. The spring-plank is discarded and the two sides of the truck are connected by two channel bars placed vertically, which also form a guide for the bolster, doing away with the usual guide bars and blocks. A, B and C are the arch and tie bars, which are connected together in the usual manner by the arch bar bolts DD and journal-box bolts EE, a malleable washer OO being placed under the heads of the former to allow for good fillet to be left on the bolt. On top of the bottom arch bar at its center is placed the spring seat FF lipping over on the sides of the bar, and also lipping up over the outsides of the transoms GG. These channel iron transoms are placed between the top of the spring seat and bottom of top arch bar and the whole is securely tied together by means of the arch-bar bolts DD, malleable castings HH being riveted to the channel bars, and forming a support for the bolts. This casting is extended toward the center of the truck and forms a bracket for the brakebeam hangers. The bolster II is of oak in two pieces bolted together and trussed by the rod JJ, for which grooves are cut out in each half of the bolster, this rod passes under a deep queen post PP at the center and the nuts on the ends rest on large cast-iron washers NN, which distribute the

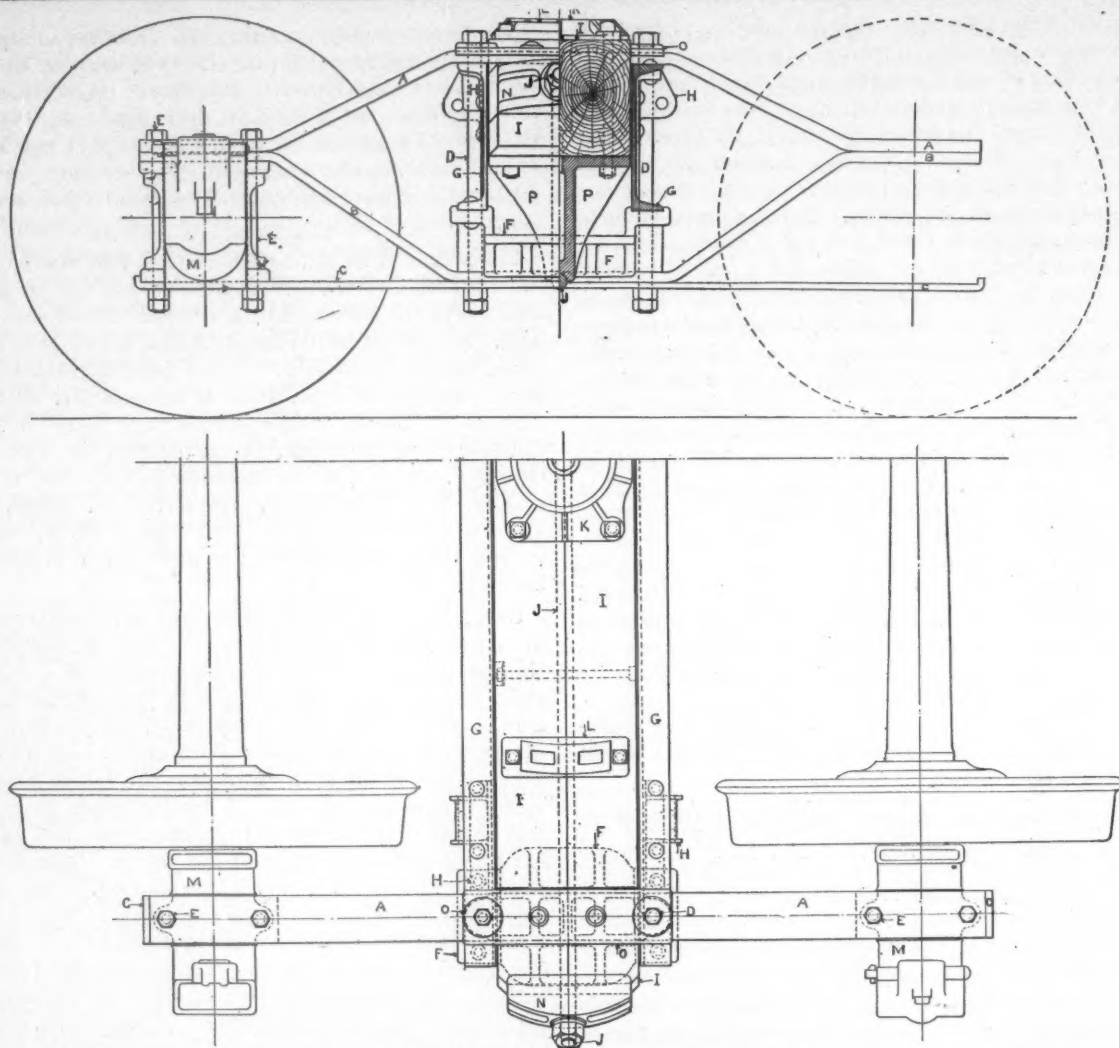


Fig. 53.—Diamond Truck without Spring Plank.

strain over the ends of the bolster. The top of the bolster near the ends is cut down about 2 inches so as to allow the ends to pass under the arch-bars and the shoulders thus formed limit the end motion of the bolster, the side motion being restrained by the transoms. Center plate *K* and side bearings *LL* are provided in the usual manner. The journal boxes *MM*, shown on these plans, are rounded on the bottom, thereby doing away with corners, which would have to be filled with waste and oil which is not utilized in the lubrication of the journal.

#### PRESSED STEEL IN TRUCK CONSTRUCTION.

On account of the extreme weight of trucks, attempts are constantly being made to lighten their construction without impairing the strength, and pressed steel seems to be the material which allows the greatest reduction in the weight. Bolsters and spring planks made of pressed steel were mentioned in previous articles, and recently arch bars have been introduced which are made of pressed steel of channel construction, instead of solid bars of iron, but as yet these have been so little used that their success is still a matter of doubt.

Trucks, made of pressed steel, and differing in their entire construction from the diamond truck, are being used considerably and have given such excellent satisfaction that many roads have adopted them quite extensively. While the repairs of these trucks, when badly damaged, are perhaps difficult to make, still it is matter of fact that they are not as easily damaged as the diamond truck, and their economy is therefore at least no less. In these trucks the springs are placed directly above the journal boxes and the truck rests on top of these springs, pedestals being provided by means of which the relative position between frame and boxes is retained. The entire frame of the truck is riveted together, forming practically one piece.

In Fig. 54 is shown working drawings of the Fox truck, which is

used the most in this country. The side frames *AA* are pressed in the shape of channel-bar section and are riveted to the two transoms *BB*, which are also of channel-bar section, the flanges on the ends being cut off and these ends being turned to form a right angle, providing the means to attach the transoms to the side frames. The two transoms are tied together by the center-stiffener *G* and by the strut *F* and base plate *C*, the two latter also forming a support for the center plate *D*. All these parts are made of pressed steel, and are riveted together. The side-bearings are supported by the side-bearing struts *HH*, which also help to tie together the two transoms. *II* is a bracket for attaching the brake-beam hanger, when inside-hung brakes are used.

The side frames are cut out at the axle centers, to receive the pedestal *T's EE*, which guide the journal boxes in their vertical motion. In the top of these pedestals are placed the top spring seats, which receive the truck springs, and the bottom of the pedestals is tied together by means of the bolts *K* passing through spread pieces *JJ* of cast-iron. All the parts which are made of pressed steel, are  $\frac{3}{8}$  inch thick, and the rivets used are  $\frac{1}{2}$  inches in diameter. Brake lever guides and fulcrums and safety chains can be attached wherever desired, as is shown on the perspective views.

Fig. 55 shows another pressed steel truck, the Schoen, which differs greatly from the one just described, in the shape of the separate parts and in the introduction of a stiffening piece of bar iron or steel.

*AA* are the top members of the frame, which also form the outer legs of the pedestals. *BB* are the bottom members, made of flat bars, and riveted to the top members at the ends over the journal boxes. These bottom members pass down on the inside of the pedestals and under the side frame diaphragms *CC*. The pedestal brackets *DD* are riveted to the bottom of the lower

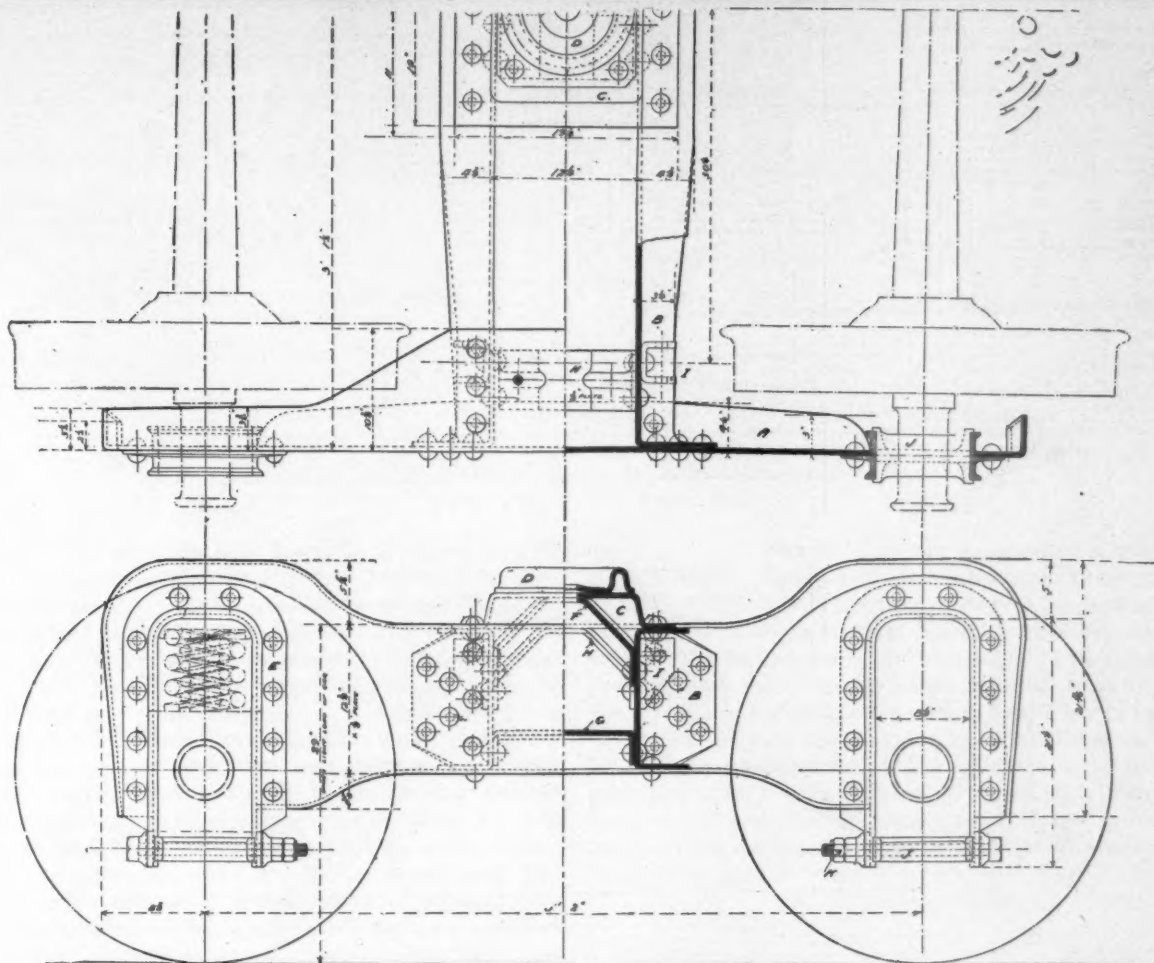


Fig. 54.—Fox Pressed Steel Truck.

members, and with these form the inside legs of the pedestals. In the top of the pedestals are placed the spring caps *EE* and the liners *KK* on the inside of the pedestals form guides for the journal boxes. The pedestal bolts *LL* tie the lower ends of the pedestals together, castings *JJ* forming distance pieces, and washers *RR* being placed under the nuts. At the center the truck sides are tied together by the bolster-channels *GG*, the ends of which are formed into right-angled flanges *TT*, stiffened by the braces *P*, pressed into the plate. The two bolster channels are tied together near their centers by the center braces *HH*, which also form a support for the center-plate. A distance plate *F* brings the center plate to the proper height and distributes the weight over a larger surface. The center plate *II* is made of the usual shape of such plates, made of pressed steel, and the side-bearings, which are shown as castings, are placed directly on the top member of the frame, without any other support. The center braces *HH* are provided at their centers near the bottom with projections *NN*, pressed in, which form a guide for the lower part of the center pin. *MM* are brackets for suspending the brake-beam hangers, when inside hung brakes are used.

#### BRAKES.

On account of the heavy freight cars of large capacity in use at the present time and the high rate of speed at which freight trains are now run, it is just as necessary, in order to control their speed, to have good brakes on freight cars as it is to have them on passenger trains, and the general adoption of air brakes on freight cars is perhaps only accelerated by a few years by the interstate commerce law, which makes it compulsory to have in every freight train a sufficient number of cars equipped with a brake by means of which the engineer on the locomotive can control the speed of the train independently of brakemen and hand-brakes. This law, together with the acknowledged advantages derived from power-brakes, have brought the air-brake to its present state of perfection, and as a modern car can hardly be

considered as complete unless equipped with such a brake, only this kind of apparatus will be touched upon.

The brake equipment of a car can be divided into two distinct parts, the foundation gear and the air-brake proper, the former consisting of the levers, connections, etc., transmitting the power applied for braking purposes to the wheels, and the latter being that part of the equipment by means of which power is delivered from the locomotive to the foundation gear.

#### FOUNDATION GEAR.

The most important point in designing the foundation gear is to so proportion the parts as to not prevent the wheels from turning when the power is applied, until the momentum of the car has been stopped, or in railroad parlance to keep the wheels from sliding; theoretically it requires a pressure upon any pair of wheels equal to the weight carried by the wheels to slide them and the maximum effect, with safety, will therefore be obtained if the pressure is so adjusted so as to be somewhat less than the minimum weight on the wheels, which is that of the car without any load divided among the several pairs of wheels. The system of levers is therefore arranged in such a manner that with a certain applied power, the total pressure on the wheels will be about 70 per cent. of the light weight of the car, this ratio having been found to be about right for freight equipment.

The arrangement of levers varies with the details of the car and is usually made so as to equalize the pressure on the different wheels and to always put a tensile strain on the connections. When it is possible, the levers and connections are placed in one horizontal plane, which is that of the center line of the air cylinder, and is generally 7 to 8 inches below the bottom of the sills.

On cars having the usual floor-frame, illustrated in a previous article, with no doors, hoppers or other attachments on the bottom, the arrangement of foundation brake, shown in Fig. 56, is most commonly used. The power of the air cylinder is applied in the direction of the arrow through the push-rod *A* to the

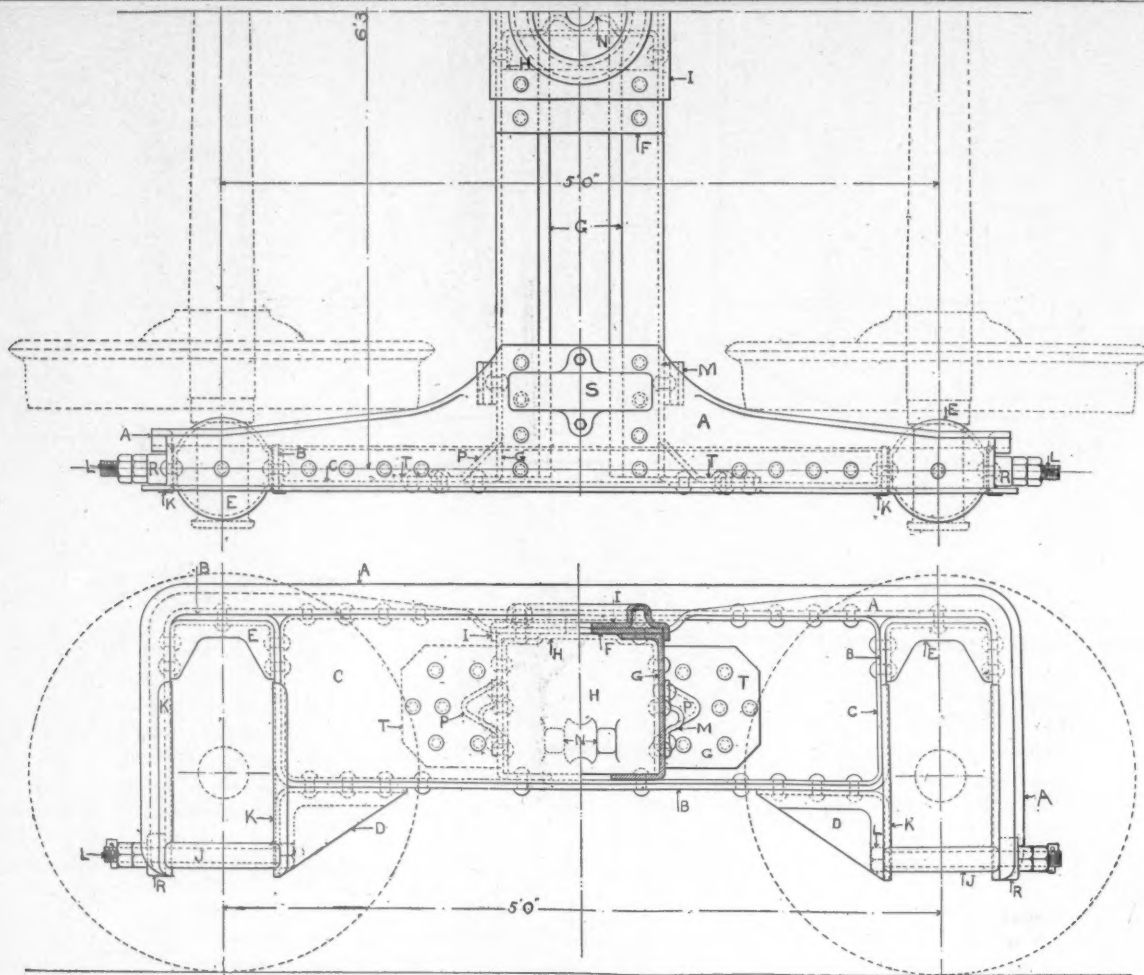


Fig. 55.—Schoen Pressed Steel Truck

cylinder lever *B*, to one end of which is attached the connection *C*, which transmits the power to the truck levers, and through these to the brake beams and shoes. At a certain point on the cylinder lever *A*, between the push-rod and the truck-lever connection, is attached the cylinder-lever connection *D*, which transmits power to the floating lever *E*, and through this to the truck-lever connection *F*, which operates the brakes on the other truck. The cylinder lever *A* is extended beyond the point where the push-rod is connected, and to this end is attached the hand-brake connection *G*, the other end of which terminates in a hook over which the chain *H* is passed, which is wound on the brake-shaft when brakes are applied by hand; when brakes are applied by power, the hand-brake connection is moved in the direction of the brake-shaft, allowing the chain to hang down slack. The ratio between the two ends of the floating lever are generally the same as that of the cylinder lever, the actual lengths being sometimes different to suit local conditions. When a hand-brake is used at only one end of the car, the floating lever is fulcrumed at one end, as shown in full lines, the support being made of flat iron secured to the crosstie timber and sills of the car. When hand-brakes are used at both ends, the floating lever is extended same as the cylinder lever, and the other hand-brake connection is attached in a similar manner, as shown in dotted lines. Provision has to be made to allow for the floating lever to be fulcrumed at the proper point when the power is applied at the cylinder lever, and also to allow for this point to be moved when power is applied at the floating lever, and this is accomplished by having the floating lever fulcrum *I* made with a slot, in which the pin through the lever is free to move to suit the conditions. The cylinder and floating levers are supported by the lever carriers *J J*, which are usually made of 1-inch round iron, bent in the shape of a U, the ends being flattened and fastened to the sills of the car by lag-screws. An error sometimes made in putting up these carriers is that of having them not long enough, so that the lever strikes the vertical part before the brakes are fully applied.

The proper effect of a force applied to a lever is obtained with any reasonable angles between the levers and their connections, but the lateral or vertical displacement of the connections arising from the motion of levers at extreme angles is so great that they are liable to come in contact with adjacent parts of the car. Furthermore, while the desired ratio between the two arms of a lever are not altered by any reasonable angle which the lever makes with its connections, providing those connections are parallel to each other, the angular position will affect the ratio between the lever arms when these connections are not parallel. It is, therefore, desirable to adjust the brake gear so that when the brakes are applied the levers will be approximately at right angles to their connections. Accurate and symmetrical adjustment of the foundation brakes should be insisted on, as it leads to the cure of many minor defects in the gear.

The operation of this system of brake is as follows: Power being applied to the cylinder lever by the push-rod in the direction of the arrow, this lever will move in the same direction, using as a pivot the point of attachment of that connection which has the most strain upon it, until the tension on the other equals it, when it will move about a point between the two, until the brakes are fully applied, thus always equalizing the strains on the connections.

When the hand-brake at the cylinder-lever end is used, the operation is the same as described, the push-rod moving out with the lever without effect on the piston of the air cylinder. When the hand-brake at the opposite end of the car is used the cylinder lever will move about the point of connection of the push-rod as a pivot, reversing the conditions of cylinder and floating levers.

The arrangement of truck levers and connections varies with the location of the brake beams; if these are hung between the wheels the arrangement shown on the left end of Fig. 56 is used—when hung on the outside of the wheels that shown on the right is the proper one. The connections from the cylinder and floating levers are attached to the tops of the live levers *K* and *K'*, a twist in the connection bringing the clevis on the proper angle to

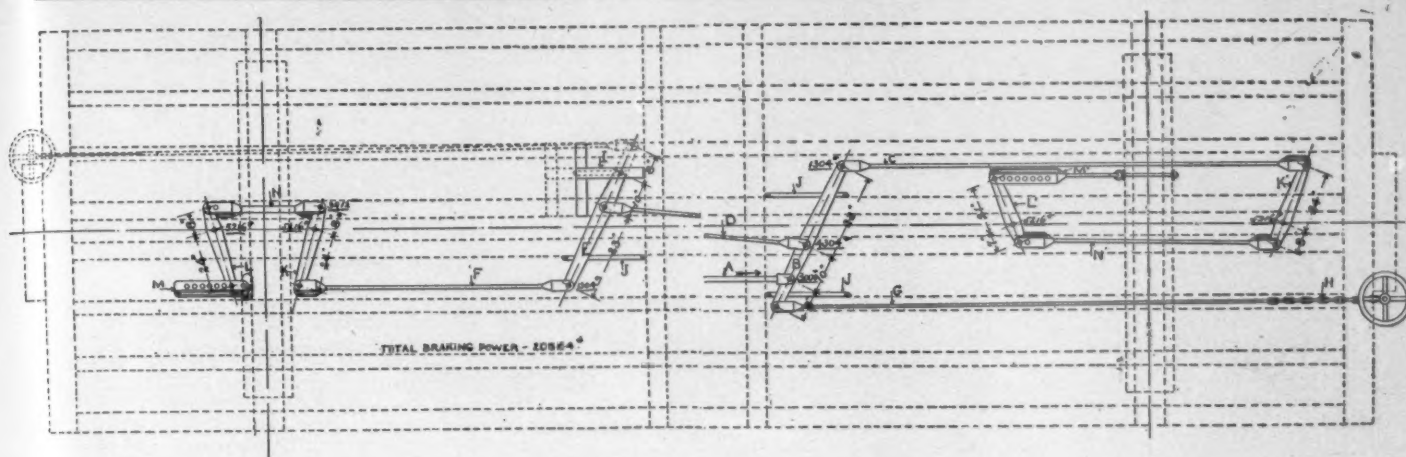


Fig. 56.—Foundation Brake Gear.

take the lever. The top of the dead levers  $L$  and  $L'$  are held in place by the dead lever fulcrums  $M$  and  $M'$ , which are fastened in a convenient manner to some part of the truck. These fulcrums are provided with a number of holes, which allow for an adjustment of the brake shoes on the wheels to make up for the wear of the brake shoes and of the connecting pins and holes in levers and connections. The lower ends of the truck levers are connected by the truck connections  $N$  and  $N'$ , which are usually provided at one or both ends with two holes to allow for a further adjustment on account of wear. When inside-hung brakes are used this connection has a compressive strain on it, and has therefore to be made considerably heavier than the other connections, and many roads are now using a casting of malleable iron for this connection instead of making them of wrought iron. When the construction of the truck will admit the connection between the truck levers is sometimes placed above the brake beam, but this is not a very common construction. On outside-hung brakes the truck connection  $N'$ , as shown, is in tension.

For the sake of uniformity the sizes of the principal parts of the foundation brakes, also the general shapes of them, have been adopted as standards by the M. C. B. Association, the most important sizes being 1 inch for the thickness of the levers,  $1\frac{1}{2}$  inches for the diameter of all the holes,  $1\frac{3}{4}$  inches for the diameter of all connecting pins, and  $\frac{1}{2}$  by  $2\frac{1}{2}$ -inch iron to be used for the clevises. The connecting rods are usually made  $\frac{1}{2}$  inch in diameter, although the bottom truck connections are sometimes made of  $\frac{3}{4}$ -inch iron, which perhaps is correct, as the strain on these is considerably more than on the others. When the brake gear is located so that the cylinder connections pass through instead of under the cross-tie timbers, the rod is sometimes cut at the center, and connected by a turnbuckle, so that a large hole need not be cut through the timber to allow the clevis to pass through.

The strains on each connection are shown in Figure 64, being based on a total pressure of 3,000 pounds on the piston, which is about the maximum obtained in an 8-inch cylinder. The figures given are calculated and levers are proportioned for a car weight ing about 30,000 pounds, 70 per cent. of which distributed on the four pair of wheels would require a pressure of 5,250 on each brake beam.

The pressure which can be applied by the hand-brakes is usually not as great as that obtained with the air, but hand-brakes are not supposed to be used in coming years, except, perhaps, in switching where the speeds are slow and a light pressure is sufficient for the purpose. When it is desired to increase this pressure and the cylinder lever cannot be lengthened a sufficient amount, a pulley can be attached to the end of this lever, with a chain passing over it, one end being fastened to the brake shaft the other one to some part of the car, such as body bolster or one of the sills, by which means the power due to the length of arm of the cylinder lever would be doubled. The pull on the brake chain is usually 1,000 to 1,200 pounds with the ordinary sizes of brake shaft and hand-wheel in use. The arrangement of foundation

brake shown in Fig. 64 is perhaps the simplest in use. On cars on which there are drop-doors, hoppers or other attachments on the bottom of the frame, it cannot, however, be used in just this shape and usually additional levers must be introduced to get around the obstructions. In some cases a rock-shaft, having levers at each end, is used to transmit power across the car where there is not sufficient space to allow a long lever to swing. Bell cranks can be used for changing the direction of the pull, such as would be necessary where the cylinder has to be placed at right angles to the connections. On cars with long and deep hoppers it is sometimes impossible to place the cylinder on the same level as the brake gear and vertical levers are introduced to transmit the power from one lever to the other.

(To be continued.)

#### Locomotives Recently Constructed by the Baldwin Locomotive Works.

In the accompanying group of photographs (see next page) we show a number of locomotives of various designs recently built by the Baldwin Locomotive Works, to whom we are indebted for the photographs and descriptions.

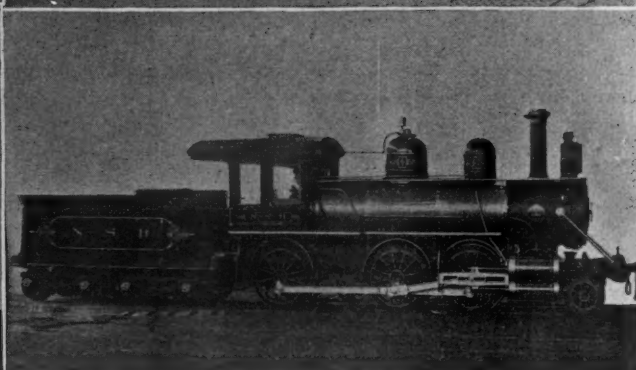
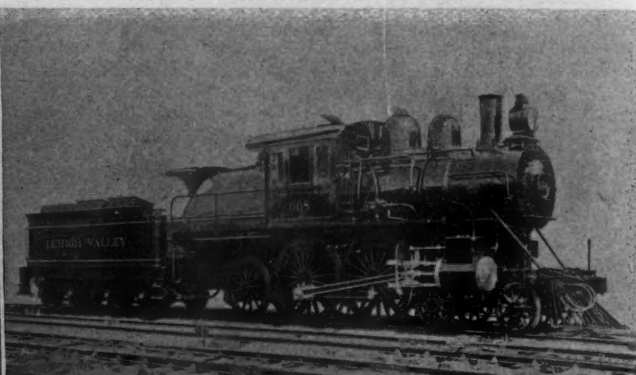
Fig. 1 is the locomotive "Moron," a double-ender, having three pair of coupled wheels and a four-wheeled rear truck, and was built for the Spanish Military Engineers, Havana. Its dimensions are:

Gage.....	4 feet 8½ inches
Cylinders.....	12 inches diameter, 18 inches stroke
Driving wheels.....	33 inches diameter; journals 6 inches by 7¼ inches
Total wheelbase.....	19 feet 5 inches
Driving wheelbase.....	8 feet, 1 inch
Weight on drivers.....	45,560 pounds
Weight, total.....	71,960 pounds
Boiler diameter.....	36 inches
Tubes.....	94 in number; 1½ inches diameter; 11 feet long
Firebox.....	38½ inches long; 33½ inches wide; 46½ inches deep
Truck wheels.....	24 inches diameter; journals 3¼ inches by 7 inches
Tank.....	1,600 gallons capacity

The cab of this locomotive is armor-clad, with  $\frac{1}{4}$ -inch steel plates on the sides and front, lined with ash. The doors and windows are provided with  $\frac{1}{4}$ -inch steel shutters to slide over the glass panes when required, the shutters being provided with loop holes in the center to allow of firing in case of attack.

Fig. 2 is a locomotive, No. 668, of the "Atlantic" type, built for the Lehigh Valley Railroad Company. Its leading dimensions are:

Gage.....	4 feet 8½ inches
Cylinders.....	19 inches diameter by 26-inch stroke
Driving wheels.....	76 inches diameter; journals 8¼ inches by 11 inches
Total wheelbase.....	24 feet
Rigid wheelbase.....	13 feet
Driving wheelbase.....	6 feet 7 inches
Weight on drivers.....	81,800 pounds
Weight on trailing wheels.....	30,050 pounds
Weight, total.....	140,950 pounds
Tubes.....	265 in number, 2 inches diameter, 15 feet 1 inch long
Firebox.....	114½ inches long, 30¾ inches wide, 40½ inches deep
Truck wheels.....	36 inches diameter; journals 5¼ inches by 9 inches
Trailing wheels.....	55 inches diameter; journals 7 inches by 12 inches
Tender tank.....	4,000 gallons capacity
Tender wheels.....	36 inches diameter; journals 4¼ inches by 8 inches



1.—Locomotive for Spanish Military Engineers in Havana.  
3.—Double-ender for a Mexican Railroad.  
5.—Double-ender for a Russian Railroad.

2.—Fast Passenger Locomotive—Lehigh Valley Road.  
4.—Compressed Air Mine Locomotive.  
6.—Mogul Compound for Norwegian State Railways.

Some Locomotives Recently Built by the Baldwin Locomotive Works.

Fig. 3 is a double-ender locomotive (No. 3), built for F. C. de Casadero a Tepetong, Mex. Its dimensions are:

Gage.....	2 feet
Cylinders.....	11 inches diameter by 16 inches stroke
Driving wheels.....	33 inches diameter; journals, 5 inches by 6 inches
Total wheelbase.....	19 feet 10 inches
Driving wheelbase.....	7 feet 6 inches
Weight on drivers.....	31,910 pounds
Total weight.....	43,410 pounds
Boiler.....	34 inches diameter
Tubes.....	62 in number, 2 inches diameter, 10 feet 11 inches long
Firebox.....	37½ inches long, 30½ inches wide, 40½ inches deep
Two-wheel truck.....	Front and back; wheels, 22 inches diameter; journals, 3½ inches by 6 inches
Tank.....	550 gallons capacity, on sides of boiler

Fig. 4 is a compressed air mine locomotive, built for the Ashland Coal and Iron Company. The following are the leading dimensions:

Gage.....	2 feet 7¼ inches
Cylinders.....	9 inches diameter by 14 inches stroke
Driving wheels.....	28 inches diameter; journals, 4 inches by 6 inches
Total wheelbase.....	5 feet 3 inches
Driving wheelbase.....	5 feet 3 inches
Weight on drivers.....	20,550 pounds
Weight total.....	20,550 pounds
Air reservoirs.....	one 26½ inches diameter, 18 feet 5 inches long; one 26½ inches diameter, 15 feet 9 inches long; one 15¼ inches diameter, 13 feet 5¼ inches long

The locomotive is fitted with an auxiliary reservoir and a reducing valve. The main reservoirs carry a working pressure of 600 pounds per square inch. The limit of height is 5 feet, width 6 feet and length 19 feet.

Fig. 5 is a double-ender locomotive built for the Krotovka-Sergievska line in Russia. Its dimensions are:

Gage of road.....	3 feet 3¾ inches
Cylinders.....	10 inch diameter, 16 inches stroke
Driving wheels.....	36¼ inch diameter; journals, 4½ inches by 6 inches
Total wheelbase.....	19 feet 9 inches
Driving wheelbase.....	7 feet 6 inches
Weight, total.....	47,160 pounds
Weight on drivers.....	33,010 pounds
Boiler.....	34 inches diameter
Tubes, 70 in number.....	1¾ inches diameter, 10 feet 1 inch long
Firebox.....	46¼ inches long, 21¼ inches wide, 43 inches deep
Truck wheels.....	24¼ inches diameter; journals 3¼ inches by 6 inches
Tank capacity.....	600 gallons (carried on sides of boiler)

Fig. 6 is a Mogul compound locomotive, built for the Norwegian State Railways. Its dimensions are:

Gage of road.....	3 feet 6 inches.
Cylinders.....	high pressure, 9 inches diameter by 19 inches stroke
.....low " " " "	15 " " "
Driving wheels.....	46½ inches diameter
Journals.....	5½ inches by 7 inches
Total wheelbase.....	18 feet 7 inches
Driving wheelbase.....	12 feet 0 inches
Weight, total.....	51,844 pounds
Weight on drivers.....	42,214 pounds
Boiler, diameter.....	44 inches
Tubes.....	157 in number, 1¾ inches diameter, 8 feet 1 inch long
Firebox.....	52½ inches long, 30¼ inches wide, 49½ inches deep
Truck wheels.....	26 inches diameter; journals, 4 inches by 6 inches
Tender, tank capacity.....	1,400 gallons
.....wheels.....	26 inches diameter; journals, 3½ inches by 6 inches

The above engine was the 15,000th locomotive built by the Baldwin Locomotive Works.

## Citizenship and Technical Education.\*

BY JOHN H. CONVERSE, A. B.

The debt which the citizen owes to the community for higher education involves an obligation on the part of the recipient which cannot in most cases be discharged by a pecuniary consideration. You who are alumni, or are to be alumni, of an institution like this are not privileged to use your intellectual equipment here acquired solely for your own aggrandizement. Society has claims upon you. In the practice of your profession you must contribute something to the welfare of the community as opportunity offers. The clergyman performs many offices of mercy for those in need, but who have no claim upon him. The physician, in his hospital practice and in his gratuitous attendance on the poor, renders an extensive service for which he receives no monied compensation. The lawyer, by his conduct of the cases of those unable to engage counsel discharges in some measure the obligation under which he rests. Are these learned professions, as they are called, alone amenable to this rule? There are emergencies and conditions where the mechanic, the engineer, the architect, the chemist, may render a valuable service to the community, and which he should regard as opportunities of privilege. You may not ask the architect to draw plans for your house without full compensation, but for an art gallery, or a hospital, or a library, for the benefit of society, you might well expect a concession in the regular fee. It is agreed that the happiest definition of civil engineering is that it "is the art of directing the great sources of power in nature for the use and convenience of man." If the engineer (and in that term we may include all the graduates of an institution like this) possesses a power so important, built up, as it has been, by the experience of thousands of predecessors, and made possible of acquisition by the founding of technical schools like this, he certainly has a duty to use it in some measure for the benefit of his fellows. Christianity teaches us that the Saviour of mankind promises the highest recognition of service done in His name to even the least of those in need. The relations of men in society show that there is an obligation of service even in the realm of materialistic progress.

The foregoing considerations lead to the inquiry, What scheme of education is best adapted to promote true citizenship? The true citizen must be more than a narrow specialist. His education must be thorough, comprehensive, humanizing, practical. The function of the university, properly so called, is to afford precisely such a training. It should include not only the humanities, but also, necessarily and inseparably, the preparation for a profession or calling.

The ideal university then might have, first, say, a three years' course in the humanities, leading as now to the degree of A. B.; and, secondly, a two years' course in technical, scientific, legal or other specific studies leading to the degree of C. E., M. E., E. of M., or other appropriate degree. And these two courses should be made, not optional, but obligatory, forming in effect a five years' course. If it be said that students will select in preference a merely technical school where in a shorter time the desired diploma may be obtained, I answer that I have no concern with that policy. My contention is that there is room for a university wherein the training afforded and enforced shall make the citizen as well as the engineer, the broadly-cultured, self-reliant man, and not a specialist exclusively.

The trend of educational development points, I think, to something of this character as the true university. A marked change has come over the schemes of higher education during the past generation. Formerly the theory in our universities was culture for culture's sake. Utility, as an essential of the studies pursued, was little regarded, or was scouted as something common or unclean. The classics, the mathematics and metaphysics constituted in the main the approved curriculum. Complete courses in chemistry, in biology and physics were rare in the department of arts. Even the modern languages scarcely ever appeared in the curriculum. The classics were emphasized to the exclusion of the natural sciences. Some in my hearing may remember the sensation produced by Charles Francis Adams, when, two or three decades ago, in an oration delivered before the Phi Beta Kappa Society of Harvard, he denounced as a fetish the slavish worship of Latin and Greek in the college course. The feeling which he then voiced has unceasingly prevailed. Since that time the change in college methods has been remarkable. Requirements in entrance examinations have been enlarged. More Latin and Greek, and mathe-

matics and English literature, and history are demanded as a condition of matriculation in order that more time in the four years' course may be available for the natural sciences, literature and the modern languages. In many colleges scientific courses and elective special studies struggle to replace the time-honored curriculum. Laboratory work has been introduced and enlarged; geology and biology are pursued by practical investigation; and even manual training and shop practice have found a place as cognate branches in some of our universities.

The significance of this movement is not far to seek. At a time when the ruling interests of the country were agriculture and the products of the forest and the sea, a college curriculum molded in mediæval form was sufficient. But with the development of mines and manufactures of every kind and the extension of new conditions of life, a different training was demanded. Our educational institutions have responded under the pressure of a new civilization. The founding of this institution 30 years ago was but the recognition in the mind of a sagacious business man of the demands of a new era of materialistic development. The shaping of its scope and purpose is an indication of the best form which is to be reached by what we call higher education.

In order that the general course may be covered in the term of three years, the time usually given to Greek and Latin might be considerably curtailed. In proposing such abridgement I am not insensible of the value of the study of the classics, but for the ordinary student without especial taste for the dead languages and their literature, I believe that much of the time ordinarily devoted to their study might more profitably be bestowed on other subjects. For all etymological and technical uses, one-half the time usually given to Greek and Latin in the curriculum would suffice.

It is undeniable that many boys enter college with no well-defined purpose as to their future. Neither they nor their parents know for what calling they are best adapted. A three years' general course, while giving them a broad and comprehensive culture, would better enable them to judge what profession or calling to adopt, and would bring them to an age of superior discretion, when their choice could more intelligently be made. The example and the influence of the engineering or special courses, of which by contact and contiguity they gain some knowledge, would greatly facilitate such choice. During the three years' general course the student would have constantly before him the suggestion and the purpose of acquiring a technical training, and would be less likely to be satisfied with the degree of A. B. alone.

Another advantage of the scheme, incidental, but most desirable, in my judgment, would be the opportunity for practical work which might be interjected between the general and the technical courses. At the end of the three years' general course let the student spend a year in actual business or work. Employment in the line of his future profession would be preferable, but failing that, any business experience would be beneficial. To illustrate this, take the case of an intending mechanical engineer. At the end of the three years' course the university might give and encourage a year's leave of absence, during which period the young man might find employment in a machine shop or factory and obtain some practical training in the use of tools and machinery. Much could be accomplished even in that brief time, and I venture to assert that there are many manufacturers in the United States who would heartily co-operate in such a scheme. The young man, after a year or 15 months of practical work, would enter upon the scientific studies in mechanical engineering with a higher appreciation of their value, with a more intelligent comprehension of their application, and with greater ability to assimilate the theoretical principles of the text-books. It is a well known fact that the best draughtsmen (and I use the term not for mere copyists, but for designers) are those who have had shop practice. They have learned what tools can do, and by what process results can be reached most economically and effectively. I need not extend the illustration. You will at once apply it to the case of the civil engineer, the engineer of mines, the chemist, and the architect.

The young man who has thus taken the complete course of five or six years will, when he finally receives his engineering degree, be entitled to stand as a thoroughly educated engineer. His culture will have been broad and liberal. He will be equipped for the highest citizenship, and he can stand as a peer of any in the community. There are few professions where the widest knowledge can more fully be utilized than in that of the engineer. No man, whatever his calling, can know too much. He will find use in the most unexpected manner for attainments apparently foreign to his pursuits. The engineer, of all men,

\* From an address delivered to the students of Lehigh University on Founder's Day, Oct. 8, 1896.

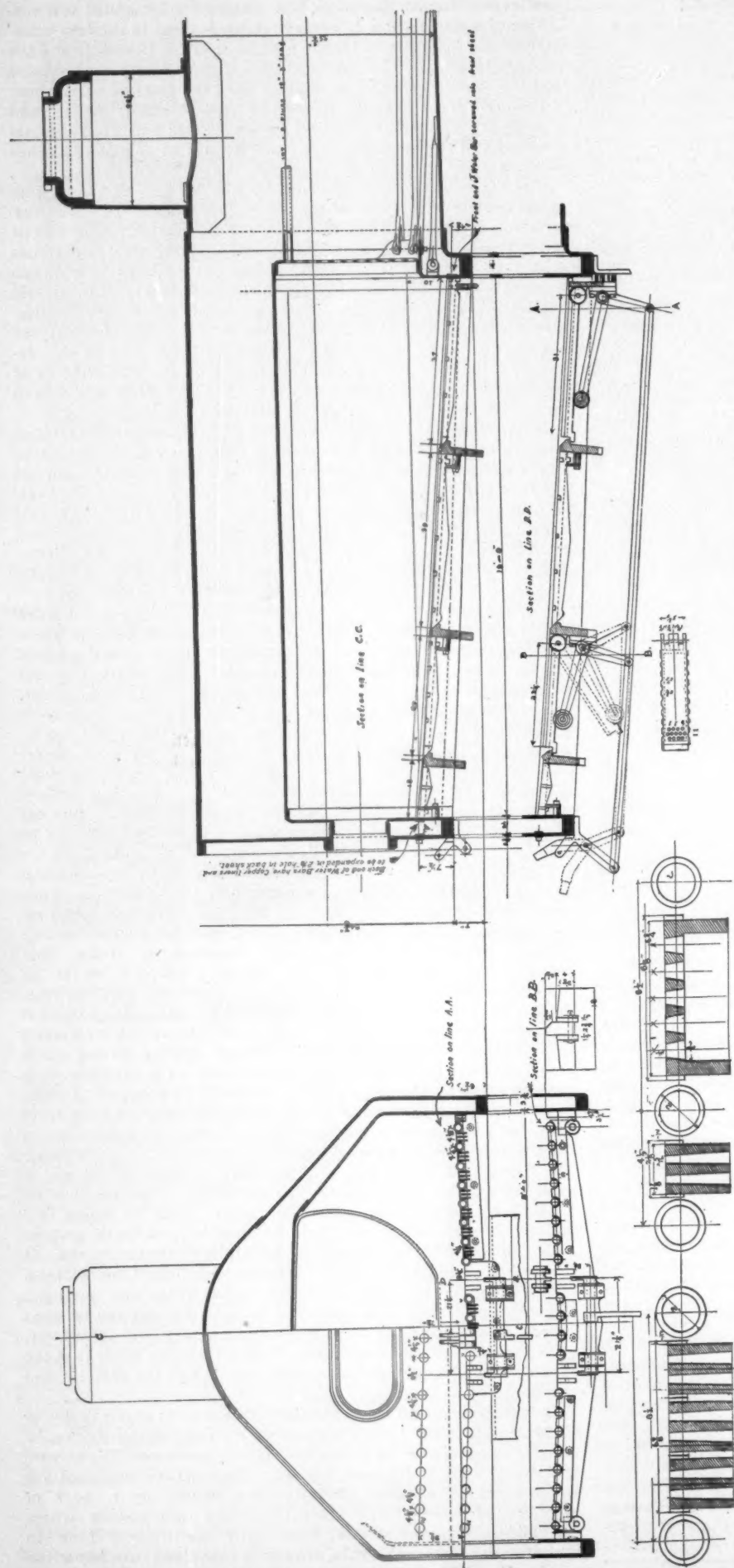


Fig. 1.—Grate for Burning Fine Anthracite Coal—Delaware, Lackawanna & Western Railroad.

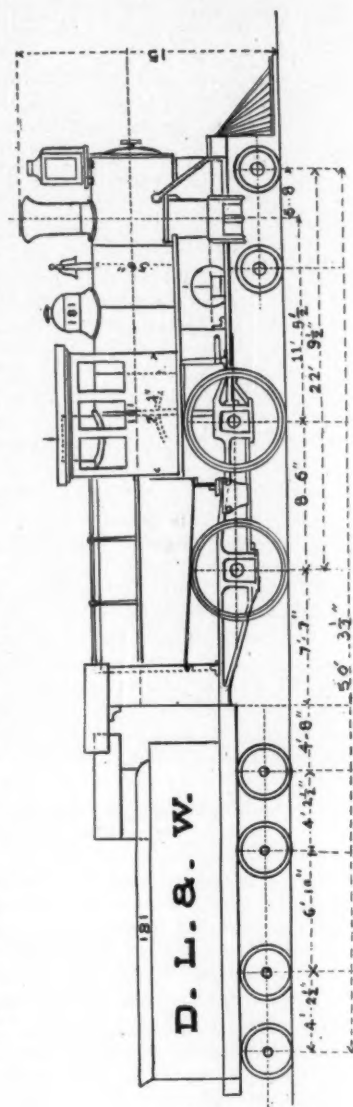


Fig. 2.—Locomotive Altered to Burn Fine Anthracite Coal.

must be a practical man, a man of business. He must be able to write concisely and vigorously. If he possesses the faculty of a public speaker, it will come in play. His knowledge of business forms and methods should be complete and exact. He should be a bookkeeper, a banker, a manufacturer, a merchant. Something at least in all these pursuits may fall to his lot in the varied conditions of his professional life. All these attainments, and more, can be utilized if he is to fulfil the definition of an engineer which I have already quoted, as one capable of "directing the great sources of power in nature for the use and convenience of man."

The young man successfully completing such a course as I have outlined has not only the liberal education which makes the man, but has also a profession or calling at his command. Uncertainty as to his future is measurably removed. He is ready to enter at once upon his life work. The contrast is marked between his case and that of the newly-graduated Bachelor of Arts of a classical or literary curriculum. The latter finds himself, not infrequently, not only with no equipment for a life work, but uncertain as to what to undertake. In many cases he is at a disadvantage compared with the boy of seventeen who has had less education but more practical experience. But the graduate of the ideal university which I have attempted to picture will be at no such disadvantage. He will be ready to take his place as a useful member of society and faithfully to discharge the duties involved in the truest citizenship.

One other advantage of such a course may be particularly emphasized. In such a five or six years' course the student will, in most cases, have before him a definite object and purpose. His studies will be pursued more intelligently and more effectively. Graduation will find him with a profession or calling enabling him at once to begin his life work. The Hebrews of old were wise in requiring every young man to learn a trade. Our educational system to-day should not prevent, but rather promote a similar policy.

In conclusion permit me to emphasize one thought. Complete as will be the education of the engineer, as the result of the system which I have outlined, it will not be all that will be required in actual business.

The education will, it is true, be an effective implement, but its owner will still have to learn its use. The interests of manufacturing and commerce have little respect for the dignity of science. Their motto is that "nothing succeeds like success." The practical man, who knows thoroughly a few things, is considered superior to the theorist, who has a practical knowledge of a variety of subjects. The graduate must, therefore, be ready to subordinate his training to the necessities of business. He will, undoubtedly, in good time, find ample opportunity to use all his acquirements; but he must be content, in entering on his work, to accept conditions as he finds them, and to wait patiently for an opportunity to utilize his knowledge. There is one term too commonly used which is mischievous in its influence. We hear of a young man seeking a "position" in a business. It is not "position," but opportunity of usefulness that should be sought. Faithful and intelligent service will generally secure recognition in the long run. A young man of my acquaintance, who had completed his course as an electrical engineer, sought employment with the Westinghouse Electrical Company. The first work to which he was assigned consisted in trueing up by hand the plates of an armature and covering it with asbestos, a process which, perhaps, could have been as well done by an ordinary laborer. The manager grimly remarked that such a job was what they usually assigned to college graduates. The young man accepted the task without a murmur, and in no long time was promoted to more important and congenial duties. Another case within my knowledge is that of a young man who had received his degree as a mining engineer. He learned that a certain smelting works in one of the Western States had applied to the President of his institution for some one to serve as helper in the assay department. The salary was inconsiderable, but the place was accepted, and within one year he had been promoted by successive steps until he was offered an engagement as manager of the works.

One more instance will suffice. At the commencement exercises of 1895 of my own Alma Mater, a young man, just graduated as a mechanical engineer, applied to me for employment. It was arranged, and, on Sept. 1 he reported for duty, and was assigned to work in running a shaping machine in a night gang. Several promotions were secured in a reasonable time, and, in May last, an application, which was received from the Government of the United States of Colombia for a principal instructor in a mechanical school in that country was filled by the nomination, by his employers, of the young man referred to. I have every reason to believe that he is satisfactorily and successfully discharging the duties assigned him.

As a general proposition, then, it may be said that the demand in business is for men who can accomplish specific results. Any opportunity of service, if in the right direction and patiently and

faithfully utilized, has in it the promise of a successful and useful career. Add the broad, complete and symmetrical training which it is the function of the university to give, and the result may be not only individual prosperity, but true citizenship.

#### Grate for Burning Fine Anthracite Coal.—Delaware, Lackawanna & Western Railroad.

On the main line of the Delaware, Lackawanna & Western Railroad most of the engines have been burning hard coal costing \$2 per ton. The coal was of the size usually burned on locomotives and the grates did not differ materially from those used elsewhere for hard coal. The company can obtain fine anthracite for 70 cents per ton, and it is clean and of as good a quality as the larger coal. Its use results in such a large saving in the fuel bills that all engines are being adapted for burning it as fast as the opportunity offers to make the change in the boilers. Mr. David Brown, Master Mechanic at Scranton, has designed the grate shown herewith for burning this fine coal and it has given excellent results. The fine coal requires a large grate area and the openings in the grate bars and between them must be small to prevent much of the coal from falling through.

From the illustrations shown herewith it will be seen that the grate is a combination of water tubes and cast-iron grate bars. For 19-inch cylinder engines the grate is of the dimensions given; that is, 10 feet long by 8 feet wide, or an area of 80 square feet. There are 20 water tubes, each 2 inches outside diameter. These are screwed into the tube sheet and expanded into the back sheet, a copper ferrule being used at the back and to make the joint tight. These tubes are spaced  $4\frac{1}{2}$  inches apart from center to center, except that the second space on each side of the center line of the boiler is  $8\frac{1}{2}$  inches. This is for the purpose of providing dumping grate bars at these places. There are three cross-bearers, on which the grate bars rest, and at the front and back ends of the box additional bearers are attached to the sheets. The fixed cast-iron grate bars rest on these bearers and almost completely fill the space between the water tubes. The bars are only  $1\frac{1}{2}$  inches wide, except at the ends, where they are 2 $\frac{1}{4}$  inches. Their openings are only  $\frac{1}{2}$  inch wide. Where the tubes are  $8\frac{1}{2}$  inches center three bars of the same pattern exactly fill the space. At the sides of the box the bars that fill the spaces between the outermost tubes and the sheets have no openings, a wise provision, as it keeps the cold air from coming in contact with the sheets.

The dumping grate bars, as already stated, are placed in the two wide spaces between the water tubes. Two of them extend from the front tube sheet to the first cross-bearer, and another pair extend from the second to the third cross-bearer. These are operated in pairs from the foot plate by the connections shown. By means of these dumping bars the fire is easily cleaned.

The engines requiring new boilers are all being provided with the large grates, and as they burn about the same amount of fine as of large coal, the cost of the fuel is reduced by the change in the ratio of \$2 to 70 cents, or to about 35 per cent. of what it was.

Fig. 2 shows in outline a 19 $\frac{1}{2}$  by 24-inch, eight-wheeled engine altered for burning the fine coal. It formerly had a firebox on top of the frames, which explains the shape of the latter. The engines of this class are doing excellent work, and as a matter of possible interest to our readers we append the following dimensions:

Cylinders.....	19 $\frac{1}{2}$ inches by 24 inches
" steam ports.....	1 $\frac{1}{4}$ inches by 17 $\frac{1}{4}$ inches
" exhaust ".....	3 inches by 17 $\frac{1}{4}$ inches
" bridges.....	1 $\frac{1}{2}$ inches
Slide valves.....	Allen-Richardson balanced
" travel.....	5 inches
" outside lap.....	3 $\frac{1}{2}$ inches
" inside ".....	line and line
Boiler, diameter of front course, inside.....	56 inches
Flues.....	218, 2 inches diameter, 12 feet 10 inches long
" heating surface of.....	1,451 square feet
Boiler, center to rail.....	8 feet 5 inches
Firebox.....	8 feet wide, 10 feet long
" grate area.....	80 square feet
" heating surface.....	140 square feet
Total heating surface of boiler.....	1,591 square feet
Weight of engine on drivers (loaded).....	84,400 pounds
" " " truck.....	34,100 pounds
" " " total.....	118,500 pounds
Tank, water capacity.....	3,700 gallons
" coal.....	7 tons
Boiler pressure.....	161 pounds per square inch

### The Explosive Properties of Acetylene.

Some experiments recently completed by Messrs. Berthelot and Vieille show that considerable precautions are necessary in dealing with acetylene, particularly in the compressed state. The gas in question is an endothermic body, that is to say, a quantity of heat is liberated on decomposing it into its constituents, hydrogen and carbon. Reasoning on this basis, the experimenters determined to try whether the gas could not be detonated by means of a cap of fulminate of mercury. This proved possible, though at atmospheric pressures the explosive wave did not proceed throughout the body of the gas, the decomposition being limited to the immediate neighborhood of the detonation. When, however, the gas was compressed, the experiments showed that it might prove a dangerous explosive. In fact, it was not then necessary to use a detonator, as it was found that the mere heating of the gas by an incandescent platinum wire was sufficient to cause an explosive decomposition of the acetylene. Average figures from a number of experiments made with different degrees of initial compression showed the following rises of pressure:

Initial pressure. Pounds per square inch.	Maximum Pressure observed on ex- plosion. Pounds per square inch.	Ratio.
31.7	138.7	4.4
49.4	271.0	5.5
85.1	600.6	7.0
160.0	1,312.0	8.2
101.0	13,028.0	10.1

On opening the steel test tube after an experiment, it was found to be filled with a mass of finely divided carbon agglomerated together by the increase of pressure. The rise of temperature at the moment of explosion was considerable, and in the case of the last of the experiments, referred to above, amounted to as much as 2,750 degrees centigrade. It was, moreover, found possible to detonate liquefied acetylene in the same way, a pressure of over 35 tons per square inch being then attained. The explosion was started, as in the previous cases, by means of a white-hot platinum wire. Dropping a bottle of the liquefied gas, or allowing a heavy tup to fall on it, proved insufficient to detonate the mixture, although when the bottle was broken by the tup a violent explosion occurred. This however, arose from the combustion of the gas, and thus differed materially in nature from the experiments previously made, in which the acetylene was merely resolved into its elements.—*Engineering*.

### Corrosion of Metal Tender Frames.

In a discussion on the preservation of metal frames for tenders and cars, before the Western Railway Club, Mr. E. M. Herr said in part:

"On the Chicago & Northwestern road we have a large number of all metal underframes on tenders which have now been in service from eight to twenty years. In general the service of these underframes has been good up to this time, and they have given but little trouble. These metal frames are now rusting away, and though none have yet corroded so much as to require renewal, the last few years' experience indicates that the amount of corrosion is increasing in an advancing ratio which will soon make extensive repairs necessary, if, indeed, entire renewal does not have to take place. This corrosion is not uniform. Those in service a long time are often not more corroded than those in service not so long. This is no doubt due to a different kind of usage and difference in the kinds of water, as, indeed, the leakage from the tank has a great deal to do with the corrosion. The following table gives the principal data in regard to these sills:

Kind of Engine.	Cylinders.	Year built.	Cap. of tank.	Max. Corrosion on iron sills.	Min. Corrosion on iron sills.	Aver. Corrosion on iron sills.
				Per cent.	Per cent.	Per cent.
8-wh. road.....	16x24	1879	2,350	10.7	4.5	7.0
" " ".....	16x24	1880	2,000	15.0	1.5	8.8
" " ".....	16x24	1888	3,000	11.2	5.7	7.8
6-wh. sw'ch'r.....	17x24	1888	2,900	11.2	6.7	9.0

"I will sum it up in saying that the maximum amount of corrosion found in the sills of these tenders which have been in service two of them 16 or 17 years, the other two 8 or 9 years, amounts to from 10 $\frac{1}{2}$  to 15 per cent. per section. The minimum amount of corrosion varies from 1 $\frac{1}{2}$  to 6 $\frac{1}{2}$  per cent., the average being from 7 to 9 per cent. This shows that the tender frames 8 and 9 years old are rusted worse in some cases than those 16 and 17 years in service."

Mr. Herr then referred to the investigation on the Eastern Railway of France, published in the August number of this journal, in which one conclusion arrived at was the desirability of painting metal frames once in three years, and states that his road has decided to treat their tender frames in the same way. He thought the paint could be sprayed on by compressed air.

### Electricity as Applied to Traction.

At the opening meeting of the twenty-third session of the Liverpool Engineering Society, the President-elect, Mr. S. B. Cottrell, delivered, before a full audience of members and their friends, his inaugural address.

He said he proposed to follow what had usually been the custom on these occasions, viz., to deal with the particular aspect of engineering with which he was himself directly interested—the development of railways. The President referred, in the first place, to the rapid expansion of railway enterprise, pointing out that while not more than 67 years had elapsed since the completion of the Liverpool & Manchester Railway, there were now open in various parts of the world upward of 400,000 miles of railway. He showed that as soon as steam power was applied to manufactures in this country railways became a necessity. Their introduction developed our coalfields, and their expansion in various parts of the world had greatly increased employment for shipping and stimulated steam navigation. After sketching the general expansion of railways, Mr. Cottrell came to the main point of his address—Electricity as applied to traction. The first great step forward in this direction was made in 1867, when Dr. Werner Siemens described to the Berlin Academy his discovery of a self-exciting dynamo, a discovery soon followed by the transmission of power from one dynamo to another. Electro-motive power, however, began in earnest with the opening of the first electric railway in Berlin in 1879. The subsequent growth of electric rails and tramways in this country, on the Continent, and in the United States and Canada, where 90 per cent. of the street railways are worked by electro-motive power, was the subject of an interesting reference. In this direction he pointed out the special value of electric traction for the purpose of inter-communication in cities, mentioning the particular instance of London, whose worst deficiencies in this respect were about to be remedied by new underground electric railways now authorized or in course of construction. By the application of electricity, the notorious discomforts of the London Underground would doubtless before long become a mere record. Discussing the application of electricity to main lines of railway, Mr. Cottrell was of opinion that the application would mean a different class of electric traction to that now employed. The present system of 500 volts continuous current had to be limited to a distance within 12 miles with any degree of economy, but by doubling the present working voltage the cost of transmission would be enormously lightened. A 1,000 volt current would not be impracticable under proper conditions as to safety. It would reduce the cost of conductors to one-fourth the present amount, and the problem would be enormously simplified by operating roads 30 or 40 miles in length from a single power station, while these stations, if placed where coal and water were abundant and worked by latest labor-saving appliances, would reduce the cost of output to a minimum, and enable power to be economically transmitted at high voltage to transferring substations on branch lines up to 150 miles away. If the suggested speed of 100 to 120 miles an hour was ever to be attained, it would be by the electric locomotive. There was practically no limit to the rotary motion of an electric motor, while, unlike the steam locomotive where the speed was increased by increasing the size of the driving wheels, and thus reducing the tractive power, the wheels might be of small diameter, which reduced the wheel base and gave the highest efficiency of tractive power. The Heilmann locomotive made a great stride in advancing electric traction, since it did not involve the use of power stations. This locomotive generated its own electricity, which was conveyed to motors fixed on the wheels. The whole weight of the locomotive was utilized for tractive purposes, and was unlike the steam locomotive in this respect, since in the latter only a small part of the weight was so made use of. Another advance was Tesla's discovery of the rotating magnetic field and the construction of a motor which dispensed with commutators and brushes, always a source of trouble and expense. These improvements pointed to others, and showed that the record of railway development, one of the most interesting chapters of practical science, was far from closed.

## New Publications.

ONE THOUSAND POINTERS FOR MACHINISTS AND ENGINEERS. By Chas. McShane, Griffin & Winters, Chicago. 328 pp., 5 $\frac{1}{4}$  inches by 7 $\frac{1}{4}$  inches.

This is a second edition of a book of the "practical" type, and intended for engineers, firemen and mechanics. There is one fact which has always been puzzling. Why is it that authors of this kind of literature seem to think that the omission of definite and indefinite articles, and other minor words, makes what they write appear more practical? As an example the directions which are given for lining up guides may be taken. These are represented in the following extract, with the omitted words in italics and parentheses.

"Measure *(the)* distance from *(the)* top of *(the)* cross-head to *(the)* center of *(the)* cross-head. Line *(the)* cylinder. Set *(the)* top guide first *(at the)* right distance from *(the)* line, use a square on *(the)* side and keep *(it)* perfectly central with *(the)* line and level with *(the)* frames. Caliper *(the)* head and set *(the)* bottom guides *(at the)* right distance from *(the)* top guide and perfectly central with *(the)* top guide. Slip in your gib and line *(it)* up close, then put up *(the)* head."

The whole book is written in this kind of railroad English, apparently with the idea that it gives to the language a sort of air of practicality. To paraphrase the language attributed to Mr. Lincoln, "If practical men like this sort of writing, then this is the kind of book which will suit them." The fact is, though, that the omission of the minor words often makes the writing indefinite, as for example when the author says, "use a square on side and keep perfectly central," it is not apparent what is to be kept central. We have inserted the word "it" on the assumption that he means the square should be kept central, but that is not certain.

The purpose of the book, the author says, is to give instruction in the "modern methods of performing work in the various branches of our trade, locomotive construction being the special feature." The discussion of the various subjects treated is a kind of combined explanation of the construction, operation, erection and repair of the different parts of locomotives. While these contain a great many very useful directions and hints to practical men, the general defect of the treatment of the subject is that they lack comprehensiveness. But it may seem to be invidious to find fault with a plate of very excellent hash by saying that it does not include soup, fish, a roast, an entree and a dessert. Good hash is excellent and very nourishing food, and has great capacity for "staying by you." Now, metaphorically, the book before us has all these characteristics. It is full of useful information and mental nourishment, and any practical or theoretical person who will study it will find that the information it contains will "stay by him" as long as life lasts.

It begins with a brief history of the locomotive and treats of the following subjects: Slide valves, link motion, steam indicators, locomotive-testing plant, cylinders, wheels and axles, shoes and wedges, rods and brasses, guides, cross-heads, etc., steam chests, pistons, rods, packings, etc., exhaust nozzles, steam pipes, etc., lathe work, metric system, injectors and checks, lubricators, steam and air gages, compressed air, locating blows and pounds, breakdowns, accidents with compound engines, Lewis valve gear, modern locomotives, fast runs, air-brake and improved tools.

The discussions of those subjects are more of the nature of practical directions how to do what requires to be done than of theoretical elucidation of them. The section relating to counterbalancing may be taken as an illustration. In explanation of the theory of it it is said:

"Reason will teach you that there is no such thing as having an engine counterbalanced perfectly at all times, for the simple reason that steam is the power, and if balanced perfectly when using steam it will not be perfect when the steam is shut off, as the steam carries the piston-head, cross-head, etc. The object is to balance the wheels as near as possible, when running, and overcome a part of the strain in the pin when shut off. But to counterbalance the parts approximately correct, so that excessive strain will not be imposed, is quite possible; care must be exercised to avoid too heavy a counterbalance, as it would give an excessive rail pressure."

Now, it would require a somewhat full dissertation in the subject of counterbalancing to show the inadequacy of the explanation of the theory, and for this there is not time now nor room here. After the explanation quoted full and specific directions are given—excepting that most of the definite articles are omitted—for arranging, proportioning and putting the counterbalances in the wheels of a locomotive. Most of the other subjects are treated in a similar way. The practical shop man will find the instructions are usually very clear, and that they will be very useful. A good index adds to the merits of the book.

A MANUAL OF STEAM BOILERS, THEIR DESIGN, CONSTRUCTION AND OPERATION. By R. H. Thurston, Dr. Eng'g, Director of Sibley College, Cornell University. New York: John Wiley & Sons. 881 pp. 5 $\frac{1}{4}$  inches by 9 $\frac{1}{4}$  inches.

There are books which are calculated to produce a feeling of dismay in the mind of a reviewer when he takes them up to summar-

ize their contents and estimate their merits in the few paragraphs which can usually be devoted to them in a notice of this kind. The book before us is one of this kind. Its size, the wide range of subjects treated, the distinguished reputation of the author and the extended field of his experience and knowledge, from which he has been able to garner its contents, incline a reviewer to hold his opinion in abeyance rather than to express it with much confidence. A review of such a book in the time and space which is available must of necessity have very much of an "impressionist" character and cannot be an adequate analysis of its contents, and mere enumeration of the heads of the chapters will indicate how impossible it would be to say more in a notice of this kind than merely to express an opinion of the scope and purpose of the book. The general subjects of the different chapters are as follows: History; Materials; Fuels and Combustion; Heat; Thermodynamics; Steam; Design; Accessories—setting and chimneys; Construction; Specifications; Operation and Care; Efficiencies; Trials; Explosions; Appendix.

The first observation which is suggested is that the book is too big. In these busy times, how many engineers can be found who have the time to wade through nearly 900 pages unless they contain matter of pre-eminent importance. Instead of this being so in the present instance, in many places the writing seems to be unnecessarily prolix. Take as an example the following paragraph:

"Safety in operation is one of the most essential requirements which the designer, constructor and user of steam boilers must be prepared to fulfill. As will be seen later, the quantity of stored heat-energy in the steam boiler is usually enormous, and this energy is stored under such conditions that, if set free by the rupture of the containing vessel widespread disaster may ensue."

It is said in the preface that the book is intended for engineers and a text-book in schools of engineering. Can it be possible that there are any persons in either of these two classes who will read such observations with either profit or interest? Would it occur to anyone worthy of being called an engineer or a student in a school of engineering to think that "safety in operation" was not "one of the most essential requirements" in boiler construction? Can it be that any person in either of those two classes is ignorant of the fact that "the quantity of stored heat-energy in the steam-boiler is usually enormous," or that it "is stored under such conditions that if set free by the rupture of the containing vessel, widespread disaster may ensue"? Or again, the chapter on Materials opens with the observation that "the quality of the materials used in the construction of steam-boilers must obviously be very carefully considered" (who thinks otherwise?) "Not only is the steam-boiler expected to bear great strains and high pressure, but the terrible consequences which are liable to follow its rupture makes it important that it should sustain its load and do its work with the most absolute safety." Who doubts it? What is the use of loading down what is intended to be "a fairly complete, systematic and scientific, yet 'practical' manual on the steam boiler, its design, construction and operation," with such commonplace remarks?

Or take still another illustration. On page 42 it is said: "Problems in steam-boiler design and construction are among the most interesting, as well as important, which arise in the practice of the engineer. These problems may and usually do take many distinct forms." Or, again, the reader is told that "the general method of solution of problems in design is to study the case very carefully in the light of all information that can be gained relating to the special conditions affecting it, and then by comparison of the results of experience with various boilers under as nearly as may be similar conditions determining the best form for the case in hand." All this is very, very obvious. Why should a book intended for full-grown engineers be loaded down with such trite observations?

Some fault may also be justly found with many of the engravings. Most of them are "process" reproductions from other engravings for which no credit is given. Some of these on pages 24, 25, 30, 32, 34, 36, 40, 148, 378, 379, 392, 396, 406 and 419 are wretchedly bad. The author and the publisher of the book would both consider it very "bad form" to appear in public with a soiled collar or shirt-bosom, but they have issued this publication with engravings which are smudged to an extent which makes them not only unsightly but incomprehensible. A collar is worn only for a day or an evening, but the illustrations of a book like this are to be presented to the public through a whole life-time or longer, and are intended to serve a much more important purpose than any merely personal habiliments ever do.

In announcing that his book "is the outcome of an attempt to meet a demand for a fairly complete, systematic and scientific, yet 'practical' manual," an author assumes the responsibility of his own reputation. In the present instance such an announcement may fairly lead the reader to expect that such an attempt would

result in a treatise which would somewhat comprehensively summarize the most important existing knowledge relating to the subject, or, in other words, that it would give a fair presentation of the "state of the art" of boiler-making up to date. Judged by this standard the book is disappointing, and is not what the reputation of its distinguished author would lead the reader to expect. The chapters on the design and construction are neither "complete, systematic, scientific," nor "practical," and, considering their importance, the treatment of these subjects is entirely inadequate for a treatise such as the one before us purports to be.

The best chapter, perhaps, is that on boiler trials, and even in that the reader must feel inclined to resent being told that in making such trials "the engineer conducting the experiments is expected to ascertain all the facts which go to determine the performance of the boiler, and to state them with accuracy, conciseness and completeness. In the attempt to ascertain these facts the engineer meets with some difficulties, and finds it necessary to exercise the utmost care and skill." Really! Some of the illustrations of the chapter on boiler explosions would be unworthy of an illustrated Sunday sensational daily or "penny dreadful." What is valuable in the book could be condensed into a half or a third of the space, and in that form would be much more useful than it now is. Those who know the admirable work which Professor Thurston is capable of and has done must feel that he has hardly done himself—or his readers—justice in the book before us.

#### Books Received.

CATALOGUE OF THE MICHIGAN MINING SCHOOL, WITH STATEMENTS CONCERNING THE INSTITUTION AND ITS COURSES OF INSTRUCTION FOR 1896-1898. Houghton, Mich. 1896.

CATALOGUE OF THE UNIVERSITY OF ILLINOIS, 1895-96. Urbana, Ill.

COMMISSIONER'S REPORT ON THE QUEENSLAND RAILWAYS FOR THE YEAR ENDING JUNE 30, 1896. Brisbane, Queensland, Australia, 1896. 66 pages. 8 inches by 13 inches.

TENTH ANNUAL REPORT OF THE COMMISSIONER OF LABOR. Volume II, 1894. Strikes and Lockouts. Government Printing Office, Washington, D. C.

SPECIAL CONSULAR REPORTS. Money and Prices in Foreign Countries, being a series of reports upon the currency systems of various nations in their relation to prices of commodities and wages of labor. Volume XIII., Part I. Bureau of Statistics, Department of State, Washington, D. C. 1896.

#### Cost of Repairs to Electric Street Cars.

In an article on "Car Trains vs. Double-Truck Cars," the *Street Railway Journal* makes a comparison between the repair expenses of short and long street cars. The long cars are mounted on two four-wheeled trucks, and have bodies 26 feet long with 18 cross-seats, giving a seating capacity of 36 in summer and 34 in winter, when the stoves are in use. The cars weigh 23,500 pounds each, and there are 44 of them in the service from which the data is collected.

The short cars are only 20 feet long over the body, are carried on four wheels and weigh 16,000 pounds. They seat 28 persons in summer and 27 in winter. They haul trailers when traffic is heavy, and these trailers weigh 5,000 pounds, and seat from 19 to 35 persons.

The cost of repairs to these cars are given in the accompanying table. The motors for the long cars are G. E. 800 and for the short cars W. P. 50.

	No. of cars.	Average seats per train.	Motor repairs.				Truck repairs.				Total motor and truck repairs per car per day.
			Total for first six months of 1896.	Per car per year.	Per seat per year.	Per car per day.	Total for first six months of 1896.	Per car per year.	Per seat per year.	Per car per day.	
Long car.	44	35	\$6,681.43	\$303.70	\$8.66	\$0.83	\$5,328.58	\$242.21	\$8.93	\$0.66	\$1.49
Short car.	74	35	7,304.04	189.74	5.42	0.52	4,274.59	111.02	3.18	0.30	0.82

From this table it will be seen that the total repairs to a long car per year is \$545.91, and for the short car the figures are \$300.76. For a comparison it would be necessary to go into many other items besides repairs (and this has been done in the article referred to), but to our readers the interesting point is that the expense for repairs should be as great as they are shown to be in the table we have copied.

#### Trials of the Pneumatic Machinery on the U. S. Monitor "Terror."

The monitor *Terror*, of the United States Navy, is a vessel that has attracted considerable attention from naval experts because of the pneumatic machinery installed on board of her. Compressed air is used to operate the gun turrets, elevate and depress the guns, hoist the ammunition, take the recoil of the guns and to steer the ship. About the middle of last month the vessel left her anchorage off Staten Island and steamed out to sea to give her guns and the pneumatic apparatus a full trial. From the account of the first day's trial, as it appeared in the New York *Sun* of Nov. 20, we take the following:

The monitor *Terror*, of the United States navy, did to-day what no other ship in the United States navy ever did. She fired solid shot at sea from her four 10-inch guns in one volley. All the guns went off as one piece. They were fired by electricity from the bridge. Nearly 1,000 pounds of powder was burned in doing it and a ton of metal was hurled into the deep. That volley represented about \$500 worth of material destroyed. The recoil of the four guns represented no less than 56,000 foot-tons, and yet the *Terror* showed scarcely a tremor as the guns plunged back from the discharge and then slid into their places.

Eight years ago Secretary Whitney of the Navy Department signed a contract with the Pneumatic Gun Carriage and Power Company, of Washington, to supply a pneumatic system of steering and of operating the machinery turrets in the *Terror*. No vessel in the world had ever made use of a pneumatic system in steering or in operating turrets, and Secretary Whitney's contract was a good deal of an experiment. It was not until yesterday and to-day that any test was made of the system. The *Terror* is still the only vessel in the world so equipped, and upon the result of this test may depend important changes in handling big guns on warships and in steering all kinds of large vessels. The trial was not fully completed, but so far as it went it was a complete success for the pneumatic system.

It is because of the fact that the *Terror* may mark another distinct advance in naval affairs by Americans that this trial trip was of unusual significance. On April 15 last the vessel went into commission. She went out cruising for two weeks in August and it was found that, so far as steering went, the pneumatic system, whether operated directly by wheels or by levers under electric control, was successful. It was also found that in turning the turrets, elevating or depressing the guns, hoisting the ammunition, loading the guns and receiving the terrific recoil after their discharge, the system was effective and superior to the use of steam or hydraulic power. The air-compressors (made by the Norwalk Iron Works Company) get up a working pressure in from two to three seconds. There is no reservoir for the compressed air except the large 8-inch pipe which runs through the ship. In this pipe a pressure of 125 pounds to the square inch is generated in 45 seconds. A small pipe leads some of this air to the steering-room. It passes into cylinders on either side of the rudderhead. A man turns a wheel in the chart-room, turret or steering room with a pressure of one finger and from one of these cylinders a big piston rod emerges and pushes the rudderhead as far as the man at the wheel desires. There is no rattle of chains, no leakage of pipes, no overheated room. When the man at the wheel wishes to throw the rudder the other way the piston from the other side darts out and the rudder goes over. A small lever can be attached to an electric motor (controlling the air-valves) and by swinging this lever back and forth the rudder goes over as easily as if a massive steam engine had done it all.

This rudder was turned to-day from hard-a-port to hard-a-starboard in the short time of six seconds. That was unheard-of speed. Remarkable time was also made in turning the monster turrets. All the air was exhausted from the compressors and the machine was started. In less than three seconds a turret weighing more than 250 tons was swinging in its circle. The compressor generated its full force of 125 pounds pressure in the short time of 45 seconds. There was no vibration to be felt in the turret, and the monster guns showed not the slightest tremor as they swung around. The turrets were turned by a simple turning engine, and the men who worked in them were not clad in oilskins, as in most turrets, but swung merrily to their work half stripped. A test was made of moving both turrets, elevating the guns and swinging the rudder by means of one compressor. In 52 seconds both turrets were completely swung around.

The speed simply astonished all the naval officers. The Trial Board consisted of these officers: Capt. P. F. Harrington, of the

**Terror;** Naval Constructor F. L. Fernald and Chief Engineer George W. Stivers, with Lieut. Albert Gleaves as recorder. The time allowance for swinging the helm clear over was 16 seconds. The time allowance for turning the turrets was also beaten by as large a proportion as the manœuvres with the helm.

The great test of the day was the volley firing from the 10-inch guns. This, too, was to be a time test. Five volleys were to be fired from them at intervals of not less than three minutes. The guns were to be loaded completely, without any previous preparation of ammunition. The crew had practically no drill in the work. It was found that the first gun in the after turret was loaded in 1 minute and 37 seconds. The first gun in the forward turret was loaded in 1 minute and 46 seconds. The second gun in the after turret was ready for firing in 2 minutes and 9 seconds, and the second gun in the forward turret was ready 23 seconds later. Thus all four guns were loaded inside of 2 minutes and 31 seconds. As soon as the guns were ready the signal to fire was given by a member of the Trial Board. Navigating Officer Curtis stooped over his electric battery, turned a handle swiftly, and at once the ship shook under the mighty reverberation of the four guns.

As we go to press word comes that the vessel's tests at sea have been completed and are eminently satisfactory.

#### Arbitration Committee Decisions.

In addition to the four items already passed upon by the Arbitration Committee for the guidance of roads during the year, and reported by us last month, the following subjects were brought to its attention at its meeting held Nov. 6, 1896, by correspondence from the members of the Association, and were considered worthy of a ruling in accordance with the instructions from the Association that the committee should make a ruling on questions arising and not settled by the rules, which ruling should stand as a part of the rules for the year:

**E.** When airbrake hose is missing it is evidence of unfair usage, and the cost of replacement is chargeable to the party having possession of the car.

**F.** There seems to be some misunderstanding also in regard to Section 49 of Rule 3, Section 15 and 16 of Rule 4 and Section 5 of Rule 5. The Arbitration Committee rules that a proper understanding is as follows:

It is the intent of the rules that a repair card should be used in all cases when repairs are made, whether such repairs are made right or wrong, or whether they are to be charged to the car owner or not.

#### THE MOST ADVANTAGEOUS DIMENSIONS FOR LOCOMOTIVE EXHAUST PIPES AND SMOKESTACKS.\*

BY INSPECTOR TROSKE.

(Continued from page 313.)

This increase of the co-efficients is graphically shown in Fig. 75. The abscissas of both diagrams give the grate areas in square feet, while the ordinates give the values of the corresponding sectional co-efficients. The co-efficients were calculated and the diagrams drawn to express an average for large and small grate areas and for different locomotives with varying ratios. It has been found that the ordinates of the connecting line for both forms of stack lie in a straight line, from which it follows:

*With an increasing grate area the sectional co-efficient increases in an arithmetical ratio.*

Referring to the throwing of sparks, it may be remarked that I found this to be no greater with the experimental stack as applied to the four-coupled Erfurt locomotive than in the case of the four-coupled express passenger compound locomotive. We can thus apply a spark arrester with this stack with the same certainty of safety that we feel in connection with the compound locomotive.

The two lines of the diagram in Fig. 75 are not parallel to each other, but that of the cylindrical stack rises more abruptly than the other, and this in such a ratio that for the same abscissas the value of its ordinates is about one and a half times as much as that of the conical stack. Thus we obtain for the same ratio

*The section of a cylindrical stack is  $1\frac{1}{2}$  times as large as that of the waist of an equivalent conical stack with a flare of  $\frac{1}{4}$ .*

Or the diameter of the cylindrical stack is equal to  $\sqrt{1.5} = 1.2247$  times the waist diameter of a conical stack with a flare of  $\frac{1}{4}$ .

In consequence of the changeability of the co-efficients it is evident that an accurate calculation can only be made by basing it upon the sectional area of the tubes.

The value of the co-efficients can, to be sure, be taken from the lines of the diagram given in Fig. 75, but, in order to give an exact

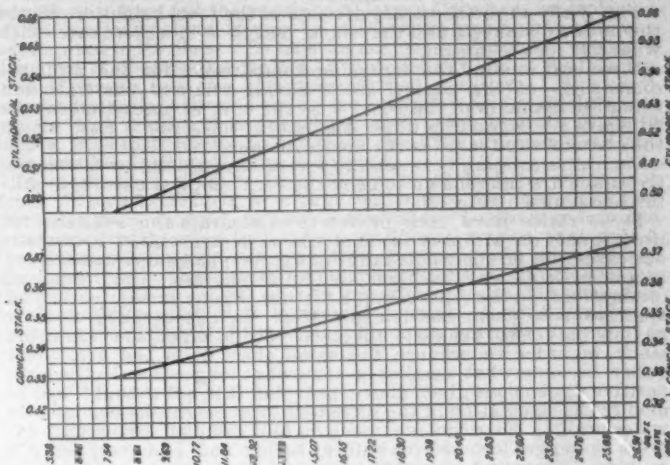


Fig. 75.

reading of the same, Table XXVIII. is appended. It gives the value of this co-efficient for 15 different limits of grate area within the limits of 9.68 square feet and 25.29 square ft. In it *fs. cyl.* = the sectional area of the cylindrical stack, *fs. con.* = the sectional area of the conical stack, contracted on a flare of  $\frac{1}{4}$  at the waist.

TABLE XXVIII.

Grate area. Square feet.	Sectional coefficient $\phi$ of	
	<i>fs con.</i>	<i>fs cyl.</i>
9.68 to 10.22	.3950	.50250
10.76 to 11.30	.3975	.50625
11.84 to 12.38	.4000	.51000
12.92 to 13.46	.4025	.51375
14.00 to 14.54	.4050	.51750
15.07 to 15.61	.4075	.52125
16.15 to 16.69	.4100	.52500
17.23 to 17.77	.4125	.52875
18.30 to 18.84	.4150	.53250
19.38 to 19.92	.4175	.53625
20.45 to 20.99	.4200	.54000
21.53 to 22.07	.4225	.54375
22.61 to 23.15	.4250	.54750
23.68 to 24.22	.4275	.55125
24.76 to 25.30	.4300	.55500

If *fr* indicates the sectional area of the tubes in square feet, the sectional area of the stack in square feet will be represented by

$$I. \quad fs = \phi fr$$

The diameter *S* of the nozzle opening can be obtained from the sectional area of the tubes by means of the formula

$$IIa. \quad fb = \frac{1}{4} fr = 0.04 fr$$

when *fb* indicates the sectional area of the nozzle.

A simpler method still leads one to the same result, if we calculate it directly from the diameter of the stack.

The equation referred to becomes

$$IIb. \quad S = \frac{1}{2} d$$

in which *d* represents the diameter of the waist of stack having a flare of  $\frac{1}{4}$ .

The nozzle distance *x* is calculated as we have indicated in section III., by the formula:

$$x = (1\frac{1}{2} \text{ to } 1\frac{3}{4}) d$$

for which we take the smaller value

$$III. \quad x = 1\frac{1}{2} d$$

This gives, empirically, a satisfactory position.

Since it is possible to take *x* as equal to  $1\frac{1}{2} d$ , the value obtained from III. can, in cases of necessity, be increased a few inches in round numbers.

How great, now, should we make the total height *H*?

In section III. it was roughly shown from the experiments with the experimental apparatus that a satisfactory construction can be obtained by making *H* from  $4\frac{1}{2}$  to 5 times the diameter of the waist of the stack; the nozzle distance *x* would then become  $1\frac{1}{2} d$ .

In section V. we saw that it is well when *H* is given to make the value of *l* and *x* as follows:

$$l = (0.6 \text{ to } 0.7) H$$

$$x = (0.4 \text{ to } 0.3) H.$$

\* Paper read before the German Society of Mechanical Engineers, and published in *Glaser's Annalen für Gewerbe und Bauwesen*.

In America it is well known that a considerably higher vacuum is used than in Germany. According to an article by Herr von Bornes, published in the *Annalen für Gewerbe und Bauwesen* in 1892, page 223, this vacuum frequently amounts to as much as from 12 inches to 15 $\frac{1}{4}$  inches of water. This unavoidably causes a large quantity of sparks to be carried through the tubes and is the reason for the application of the large smokebox; for, in this way, the particles of coal that are carried through the tubes can be collected in the front end and the ample space provided enables this to be done without quickly clogging the lower tubes and thus interfering with the steaming capacity of the boiler.

From this we may take as approximately the average values as follows:

$$\text{IV. } \begin{cases} l = 0.666H = \frac{2}{3}H \\ x = 0.333H = \frac{1}{3}H \end{cases}$$

From III. we now have

$$x = \frac{1}{3}d, \text{ which gives } \frac{1}{3}d = \frac{1}{3}H, \text{ or } H = d = 4\frac{1}{3}d.$$

The total height  $H$  of the stack is thus made dependent upon the diameter  $d$  of the waist. But it can, nevertheless, be increased a few inches without any hesitation.

Fig. 76 shows the necessary division of the total height of  $H$  into the nozzle distance  $x$  and the stack length  $l$  in accordance with what has just been said.

If we bear in mind the foregoing comparisons for the principal dimensions of the conical stack having a flare of one-sixth and using the diameter of the waist  $d$  as the unit of measurement we will have  $l = 3d$ , and the upper diameter of the stack  $= 1\frac{1}{2}d$ , which thus becomes the same as the nozzle distance  $x$ .

The ratios existing between the several dimensions of a locomotive stack are thus shown to be of the very simplest nature, as still further shown by Fig. 77.\*

These ratios have been proven to be accurate and available for use not only on ordinary locomotives, as demonstrated in numerous cases, but on the whole range of express, passenger and freight locomotives, as well as upon switching engines. For compound locomotives, on the other hand, a further change is required, as an application to them has demonstrated. In consequence of their having only two exhausts for each revolution of the crank, the stack, in order to produce the same effect upon the fire, must either be somewhat smaller or somewhat longer than in the comparative dimensions given above, provided it is not thought best to modify the calculation of the increased total height by the use of a wider bridge. Experiments made on four coupled compound express passenger locomotives built at Erfurt and Hanover and six coupled compound freight locomotives gave a satisfactory working of the smokestack, if the total height was equal to five times the diameter of the waist; that is, when  $5dH = 5d$ , and, likewise, when  $l = 3\frac{1}{2}d$ . The above ratio of stack could then be taken as in the ordinary locomotive.

The foregoing rules are for conical stacks that have a flare of one-sixth over their whole length. If we wish to use a stack having another inclination, it is necessary, as we have already shown in connection with Fig. 74, to make a corresponding adjustment of the diameter of the waist as calculated in table XXVIII. for the new flare. This must be positive for a flare less than  $\frac{1}{6}$  (as  $\frac{1}{8}$ ,  $\frac{1}{10}$ , etc., for example), and negative for such as are greater than  $\frac{1}{6}$  (as  $\frac{1}{4}$ , etc., for example). It is merely stipulated that, according to

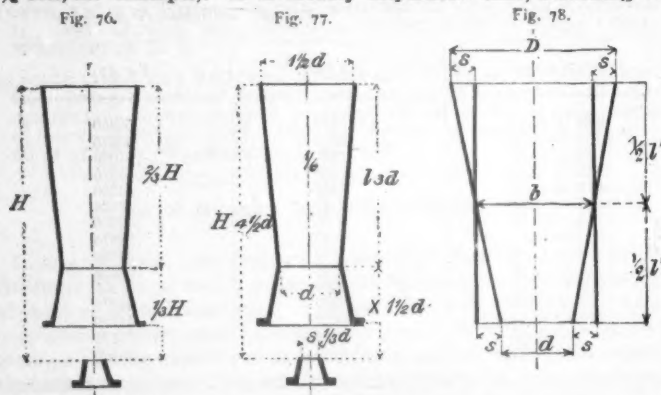


Fig. 73, the average cross-sectional area located at a distance of  $\frac{1}{2}l$  above the waist should remain the same. The length of  $l$ , may, however, change with the diameter  $d$ , according to the following observations:

According to Fig. 78, let the upper diameter, at a distance  $l$  from the waist, be represented by  $D$ ; let  $s$  be the average diameter, and  $s$  one-half of the difference between the largest and the smallest diameters, hence we have for a stack with a flare of  $\frac{1}{6}$ :

$$\begin{aligned} D &= d + \frac{1}{3}l \\ D &= d + 4s \text{ and } \\ l &= 24s \end{aligned}$$

The average diameter is

$$\sigma = d + 2s = d + \frac{l}{12}$$

which gives

$$\text{VI. a } l = 12(\sigma - d).$$

\* With regard to the construction of locomotive smokestacks the recommended practice of  $x = \frac{1}{3}H$  should be especially referred to Section Vb. It will be remembered that it was there shown that the lower third of the total height of the stack is without any marked influence on the action of the draft, provided that the jet of steam with its entrained accompaniment of the products of combustion find a free entrance. The latter statement tallies with the relative width of stacks that were laid down in Table XXVIII. It is, therefore, from this fact that a particular shape at this point is a matter of no moment; that the so called "foot" of the stack has been developed. It will even be found that the stack can be lengthened downward a certain amount, thus lengthening  $l$  and shortening  $x$ , and also at the same time contracting the new diameter of the waist without in any way materially injuring the efficiency of the action of the stack. For this reason it is my opinion that many of the special bases and stacks that have been cast for individual locomotives have been a waste of time, money and trouble. They are only suitable where the distance from the nozzle to the top of the smoke-box is greater than  $1\frac{1}{2}d$ , or where the shell of the stack-pipe projects through the plating and comes down into the smoke-box.

Hence, as the cross section of a cylindrical stack is equal to  $1\frac{1}{2}$  times that of the corresponding conical stack having a flare of  $\frac{1}{6}$ , we also have

$$\sigma = 1.2247 d$$

whence we obtain from VI. a

$$\text{VI. b } l = 2.6964 d = \infty 2.7 d.$$

By this equation we obtain from V. the resulting ratio of

$$d = \frac{1}{3} H,$$

whence we obtain from  $l$  the simple equation

$$l = 2.7 \times \frac{1}{3} H$$

or

$$\text{VI. c } l = 0.6 H.$$

Whence the simple length of stack  $l$  (see Fig. 76) is, according to 12, equal to  $0.666 \dots H$ , so that it happens that for the change in the flare of the stack, the corresponding length  $l$  is about  $\frac{1}{3} H$  shorter than before. Therefore if we wish to keep the length  $l$  constant it will be necessary to enlarge the stack.

In the summary given at the conclusion of this paper, the differences between the diameters of the cylindrical and equivalent conical stacks having a flare of  $\frac{1}{6}$  is given in a separate column; which was averaged from a series of experiments with an indicated stack, and calculated.\* If this difference be multiplied by 12 in accordance with VI. a we will have  $l$ .

If the diameter of the cylindrical stack is not calculated,  $l$  will either be fixed according to VI. b or, simpler still, according to VI. c. In compound locomotives  $l$  will likewise be as large as in ordinary locomotives. If  $H$  be assumed then  $l$  will be equal to  $0.54 H$ , according to the first and larger values of  $H (= 5 d)$ .

As soon as  $l$  is determined, then the necessary enlargement of the waist of a stack having a flare of  $\frac{1}{6}$  can be calculated. An example may make this clearer.

Let us take, for instance, a locomotive having a grate area of 24.74 square feet, the sectional area of the cubes being 3.12 square feet. According to equation I and table XXVII, a conical stack having a flare of  $\frac{1}{6}$  will have a sectional area at the waist,  $fs = .37 \times 3.12 = 1.15$  square feet, which gives  $d = 14.57$  inches and  $H =$

\* Example 1. The eight-coupled consolidation compound freight locomotive of the Prussian State Railway required, according to the conclusion given in the general review in Section XII., and with a stack having a flare of  $\frac{1}{6}$ , a diameter of waist of 16.14 inches, with the total height  $H = 5 \times 16.14 = 80.7$  inches;  $l = 3\frac{1}{2} \times 16.14 = 56.49$  inches, and the nozzle distance  $x = 1\frac{1}{2} \times 16.14 = 24.21$  inches. The nozzle diameter thus becomes  $\frac{1}{4} \times 16.14 = 3.78$  inches. If we make the flare of the stack  $\frac{1}{8}$  instead of  $\frac{1}{6}$  the diameter of the waist must be made  $16.14 + 1.81 = 17.95$  inches, whence  $l$ , according to equation VI. b is equal to  $2.7 \times 16.14 = 43.58$  inches.

Owing to the high position of the boiler on this locomotive it was impossible to get a total height of stack of 80.7 inches. In fact it could only be made about 53.14 inches. The calculated stack had, therefore, to be shortened about 27.56 inches, which means that the length  $l$  was  $56.59 - 27.56 = 29.03$  inches. According to Plate IV., under IV, it appears that a funnel-shaped stack, 4 feet 9.68 inches long, when shortened 27.56 inches, shows a diminution of the vacuum of about .87 inches of water, the abscissas being  $24.21 + 17.52 = 41.73$  inches and the nozzle diameter 5.32 inches. The shortened stack must then be given such an increase of flare that this lowering of the vacuum will be compensated. According to the said Plate IV., we find that this contraction will amount to about 1.97 inches; for the stack with a flare of one-twelfth, with a diameter of 15.75 inches, when shortened 27.56 inches, shows a vacuum of 3.7 inches at an abscissa of 3 feet 5.73 inches, which with a stack of the same length, but having a diameter of 13.78 inches, shows a vacuum of 4.69 inches, both nozzles having a diameter of 5.32 inches (a mean between 5.51 inches and 5.12 inches), or a difference of .99 inches. The diameter of the waist, which was 17.95 inches, thus becomes in the new stack of one-twelfth flare only about  $17.95 - 1.97 = 15.98$  inches, with a length  $l = 28.94$  inches and a nozzle distance  $x = 24.21$  inches. The eight-coupled consolidated locomotive in question worked satisfactorily with a waist diameter of 15.75 inches; a length  $l = 28.55$  inches and a nozzle distance  $x = 24.02$  inches, while the nozzle diameter is 5.12 inches.

Example 2a. The eight-wheeled, four-coupled compound express locomotive of the Prussian State Railway permits the use of a total height of stack  $H$  of about 5 feet 4.96 inches, provided the nozzle is not placed below the upper row of tubes. According to the statement already made, the stack having a flare of  $\frac{1}{6}$  must have a waist of 14.53 inches in diameter;  $H$  would then be equal to  $5 \times 14.53 = 72.65$  inches in round numbers;  $l = 51.18$  inches and  $x = 1\frac{1}{2} \times 14.53 = 21.78$  inches in round numbers, and the nozzle diameter must be 4.86 inches. The calculated length of stack thus becomes 7.87 inches shorter, that is to say  $l$  will be equal to 43.31 inches. According to Plate IV., under IV., the length of a funnel shaped stack with a flare of  $\frac{1}{8}$  is 4 feet 9.68 inches, with a nozzle diameter of 4.74 inches and a diameter itself of 15.75 inches, producing a vacuum of 4.69 inches, which drops to 3.94 inches, with a stack length of 4 feet 3.18 inches, and to 3.66 inches, with a length of 3 feet 7.31 inches. Shortening the stack 7.87 inches also lowers the vacuum from 3.94 inches to 3.66 inches, or .28 inch. This slight fall can best be met by the application of the bridge.

According to Plate VI. under D, with an abscissa of  $21.65 + 17.52 = 39.17$  inches, the vacuum of a funnel-shaped stack 4 feet 9.68 inches long, with a flare of  $\frac{1}{8}$  and a diameter of 15.75 is increased about .37 inch by cutting down the stack 15.75 inches at the top, if, at the same time, instead of a nozzle 4.74 inches in diameter one with a bridge .63 inch wide and 5.12 inches in diameter is used. But since, in this case, compensation must be made for only .27 inch, a somewhat narrower bridge can be used. This locomotive, with a stack having a flare of  $\frac{1}{8}$ , a diameter of 16.14 inches (having been substituted for one with a flare of  $\frac{1}{6}$  and a diameter of 14.53 inches) with  $l = 43.31$  inches  $x = 21.65$  inches and a nozzle 5.12 inches in diameter provided with a bridge, generated sufficient steam for its work and yet threw less sparks than the old and smaller stack had done.

b. The same good results were also obtained with a stack .59 inch smaller, while the other dimensions were kept the same as in the stack of 16.14 inches diameter just mentioned. According to the plates, the vacuum was increased about .27 inch by this contraction of .59 inch. If a bridge .35 inch wide is used the diameter of the nozzle can be increased to 5.28 inches.

c. By dropping the nozzle down below the top row of tubes, the calculated total height,  $H = 6$  feet 0.81 inch, of stack can be obtained. On an eight-wheeled, four-coupled compound express locomotive, the fire was worked in a satisfactory manner, with a cylindrical stack having a diameter of 17.72 inches, a length of stack proper of 4 feet 2 inches, a nozzle distance of 22.84 inches and a nozzle diameter of 5.12 inches provided with a bridge .31 inch wide, and this too when the engine was severely crowded.

$4\frac{3}{4} \times 14.57 = 65.66$  inches, = 5 feet, 5.66 inches,  $V$  will then be equal to  $2.7 \times 14.57$  or  $0.6 \times 65.66 = 39.4$  inches (1. m.).  
whence  $\frac{V}{2} = 19.7$  inches. (500 mm.).

In a height of 19.7 inches the contraction at the bottom is the same as the widening at the top.

In stacks with  $\frac{1}{4}$  flare we have  $\frac{19.7}{6} = 3.28$  inches.

" " "  $\frac{1}{8}$  " "  $\frac{19.7}{8} = 2.46$  "

" " "  $\frac{1}{16}$  " "  $\frac{19.7}{10} = 1.97$  "

" " "  $\frac{1}{32}$  " "  $\frac{19.7}{12} = 1.64$  "

Etc.

Again the stack with a flare of  $\frac{1}{4}$  has a smaller waist than the—  
Stack with a flare of  $\frac{1}{8}$  by  $3.28 - 2.46 = .82$  inch.

" " "  $\frac{1}{16}$  " "  $3.28 - 1.97 = 1.31$  inches.

" " "  $\frac{1}{32}$  " "  $3.28 - 1.64 = 1.64$  "

Thus the adjustments  $2s$  for the diameter of the waist calculated in accordance with Table XXIII. are established.

By maintaining a greater diameter of stack at the waist, the nozzle distance, as calculated according to equation III., remains unchanged as well as the total height  $H$ , together with the nozzle diameter that was calculated according to II.  $b$ . Now, if our stack having a flare of  $\frac{1}{4}$  is replaced by one with a flare of  $\frac{1}{8}$ , the diameter of the latter would then be, in round numbers,  $14.57 + 1.61 = 16.18$  inches. It would have a total height of  $H = 14.57 \times 4.5 = 65.57$  inches,  $l = \frac{3}{4} \times 65.57 = 49.18$  inches, and the nozzle distance  $x = \frac{3}{4} \times 65.57 = 49.18$  inches, while the diameter of the nozzle itself would be  $\frac{3}{4} \times 14.57 = 4.36$  inches.

If we make an application of these dimensions to a compound locomotive having the same grate area and sectional area through tubes,  $H$  and  $l$  will be increased by about  $\frac{1}{4} d$ , so that  $H = 72.84$  inches and  $l = 50.98$  inches. All of the other dimensions, as well as the converted length  $V$ , will be the same as in the ordinary locomotive.

From the foregoing discussion of the change in the flare of the stack it is evident that advantage should be taken of its peculiarities if the dimensions of different stacks are to be so adjusted as to make a comparison of their action with each other. To do this they must be changed to the same flare; furthermore, it is also necessary to bear in mind the different nozzle distances, that these may also be made the same for the purpose of a calculation, and whether the stack itself has actually been lengthened or shortened. Then a fresh comparison of the stacks with reference to their diameters and lengths becomes possible.

In this way it is often found that on locomotives with ratios already established the stack is too small for a large nozzle opening, and on the other hand the stack is too large for the small opening. According to the deductions obtained from sections III. to V., the same vacuum can be produced with both arrangements. According to the statement made in V.  $e$  the latter arrangement (the large stack) is usually the one to be preferred, especially, and this must be distinctly emphasized—there should never be too great a contraction of the nozzle opening (the calculation being correct) lest there be a corresponding back pressure put upon the steam piston, as a result, as was clearly shown by the Templehof experiments. This interrelationship existing between the stack and the nozzle must be kept constantly before the eye in the determination of the dimensions to be given to these parts. No accurate rule for the influence and action of the draft upon the fire is rendered possible by the knowledge of the dimensions of only one of these parts.

The stack and the nozzle must, rather, always be examined together.

According to the deductions obtained from Section XI., it is seen to be purely a matter of taste as to what shape of stack shall be used, whether cylindrical or conical, especially as the cost scarcely enters into the question.

When it so happens that the height available in the construction is not as much as that demanded by equations V and  $V_a$ , then the shortened stack must be made correspondingly smaller. The lines of the diagrams in Plates III. and IV. show this without any further rule. If the stack is made a few inches longer than the established length, as in the case of a tank locomotive, for example, where it was done for the sake of avoiding a smoke annoyance to the men; then, if the action of the draft is to be kept the same, it must be made larger in diameter according to Table XXVIII. The Plates mentioned also give the necessary data.

It must be remembered just here that the value of the vacuums given in these tables must be understood to be only approximations for general application. They were obtained on the experimental apparatus under the conditions existing on a passenger locomotive, and therefore coincide in the first line with that of those locomotives of similar conditions and sizes. But the latter ones are only definite for the first position of the air openings; still, as the draft ratios of all locomotives are very much alike, the results obtained by these experiments can be adapted to a general application and the plates admit of being transferred to locomotives of a different kind.

For the purpose of making an average of the conditions prevailing in practice, locomotive experiments were instituted, using both pure Silesian coal and a half and-half mixture of this and of Westphalian coal. When a stack designed in accordance with the foregoing rules failed to make steam enough on account of the fuel used, the draft could be readily adjusted and made sufficient by the application of a bridge to the nozzle.

Still, it is not alone the kind of fuel that influences the draft in a way that the formulae cannot be applied in a definite manner, but particularly that wide variety of arrangement that prevails in the designs of locomotive boilers and their appurtenances, such as

similar grate areas and sectional areas through the tubes. Greater length of flues and closer meshes in the spark arresters may likewise diminish the draft and necessitate a variation from the calculated dimensions. The simplest way of meeting this difficulty is, as we have already demonstrated, by the application of a bridge to the exhaust nozzle. Suppose, for example, that the draft is too weak, it can readily be strengthened by the application of a bridge of a suitable width, while the diameter of the nozzle is also increased. Suppose it is too strong, it is, on the other hand, merely necessary to bore out the nozzle to a larger diameter, or, in case a bridge is already there, it can be made narrower or a smaller one substituted in its place. By this means, especially on the trial of a new type of locomotive, we can advantageously make the change if we desire to test the steam-generating qualities. Likewise, it may be desirable to furnish the driver with a few bridges of different widths and depths that vary from each other by from .05 to .10 inches, with instructions to try them one after another until the best possible draft on the fire is obtained.

In most cases a bridge from .20 inch to .27 inch in width and from .16 inch to .20 inch in height will suffice for increasing the draft a suitable amount, so that in general the nozzle may be made a few hundredths of an inch larger in diameter than that called for by the calculations. It was also shown by the experiments mentioned above that no marked increase in the back-pressure on the pistons is to be feared as the result of the application of so small a bridge. But if it is desired to make a considerable increase in the strength of the draft it becomes necessary to adopt a

Fig. 79.

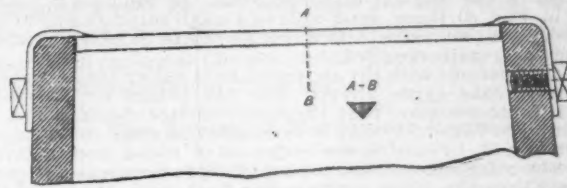


Fig. 80.

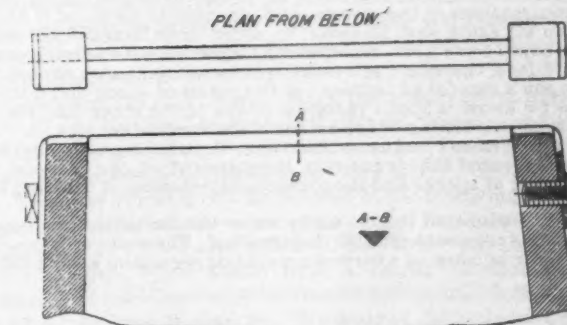
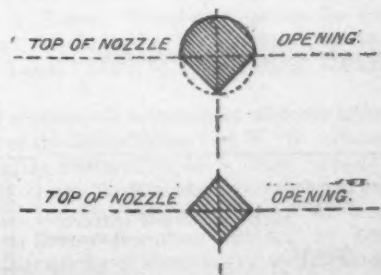


Fig. 81.



wider bridge, say from .30 inch to .47 inch, and at the same time increase the diameter of the nozzle from .20 inch to .30 inch, by which means the steam jet will be given a sharper divergence and thus fill the stack more quickly. An example of this is furnished by the case of an eight wheeled, four-coupled Erfurt locomotive, the diameter of whose nozzle was calculated at 5.02 inches, but which was actually made 5.12 inches, and a bridge .31 inch applied. In consequence of this, with a conical experimental stack 14.96 inches in diameter at the waist and a flare of  $\frac{1}{4}$  (the length being like that given in the annexed review at the conclusion of this article), the calculated nozzle distance could be decreased from 22.44 inches to 8.5 inches. In the same way on a locomotive of similar construction, a cylindrical stack, having a diameter of 18.70 inches, was taken instead of the calculated size of 18.31 inches, since the same nozzle (5.02 inches in diameter) was enlarged to 5.19 inches, and a bridge 43 inches wide applied. In both cases the consumption of fuel and the generation of steam was satisfactory.

With the cylindrical stack the nozzle opening was placed so low that it was almost flush with the top row of tubes, so that the proper constructional height  $H$  was obtained. It is well known that this low location of the nozzle has had many applications on the large English locomotives, among others on the so-called single-driver engines of the Great Northern Railway, which, with drivers

1. The change of the stack with a flare of  $\frac{1}{2}$  for one of a lighter flare, but larger waist follows from the rules given in Section XII.  
2. Such a change may be an equivalent.  
3. The total height of the stack as well as the nozzle distance can be obtained within a few fractions of an inch.  
4. In compound locomotive the length  $l$  and the total height  $H$  is about one-half the diameter of the stack (the flare being  $\frac{1}{2}$  greater), all other dimensions remaining unchanged.  
5. The locomotives in the table marked (\*) and (†) indicate that the experimental stacks of the dimensions given were tested in service, and this was done, with the exception of the four-coupled six-wheeled express locomotives, both with the conical and cylindrical forms. The simple engines are marked (\*) and the compound (†).

## The Situation in China and Japan.

(WRITTEN FOR THE AMERICAN ENGINEER.)

It is to the interest of American manufacturers of railroad material, cars, etc., that they should understand the changes in China effected by the late war in Japan. Before the peace of Shimonoseki, the Chinese mandarins violently opposed the introduction of any innovation, threatening to do away with their influence and perquisites. But since peace was restored, two powerful influences have been at work among them. First comes the hatred inspired by the success of the despised Wo-Jin, or pigmies, as they contemptuously name the Japanese; and second the fear of dismemberment unless China acquires the means of consolidating her strength. Besides these impulses working internally, the Japanese have been instrumental in removing the barrier which kept the interior of China closed to foreign enterprise. This fact is so important that some space may be devoted to an explanation.

When peace negotiations between Li Hung Chang and Marquis Ito were in progress in Shimonoseki, the Japanese Prime Minister feared that England would object to the cession of the Liao Tung Peninsula. To propitiate this power, Ito insisted upon the insertion of the following three clauses:

1. The opening of several new ports.
2. The right of Japanese subjects to manufacture in the open ports of China; and
3. The abolition of the li-kin duty.

As to the first clause, this was simply establishing so many new markets for foreign products; but as these ports are situated in the poorer districts of China, the advantage to foreigners was not great. Another thing, however, was the second clause. The right of manufacturing had been reserved to the mandarins, but by the "favored-nation" clause of China's treaties with other nations, no privilege whatever can be granted to any nation which is not shared by all alike. This clause, then, threw China open to foreign manufacturers, and many were not slow to avail themselves of cheap wages, cheaper coal and transportation.

But the most important of all clauses was the abolition of the li-kin duty. The import duty in China is almost uniformly 5 per cent. *ad valorem*, and is immutable, being regulated by treaty, while China neither demands nor is likely to obtain tariff autonomy within our lifetime. But the mandarins have appropriated to themselves the right to collect a toll on all merchandise passing through their territory. The rivers are the great arteries of trade, but these magistratures are very close together, so that the frequency of this toll acted in reality as a prohibitory tariff. Its abolition has therefore opened China to foreign manufactures.

Up to the close of the war the only railroads existing in China were from Tientsin to Shanhai Kwan, 25 miles, and from Tientsin to the Kai Ping coal-fields owned and operated by Li Hung Chang. This last-named road is 67 miles long. Both roads are the property of the wealthy viceroy, but are wretchedly equipped and managed. Li Hung Chang's great rival in power was and is to-day Chang Chih Tung, who, while still in Peking, advocated the construction of railroads, but with Chinese capital and under China control. Through Li Hung Chang's influence he was appointed viceroy of the two Kiangs' wealthy provinces about the Yang-tse River, and of which Nanking is the capital. Here he was told to carry out his projects, and he proceeded to do so in a characteristic Chinese way.

He decided first to intrust the building of railroad shops to a nationality not powerful enough to make its influence felt, and his choice fell upon Belgium. He engaged as chief engineer Mr. Paul de Hees, who had constructed many of the railroads in Turkey, and a staff of engineers of the same nationality and located the shops at Hankow, 400 miles up the Yang-tse. The work was, however, taken up and carried on in a most desultory and unsatisfactory manner until after the close of the war. Surveys have been made for the line between Nanking and Peking, a distance of 1,407 miles, and the work is now going on with more energy.

Mr. de Hees is a great admirer of American railroads and railroad material. He has visited this country, and is determined to

closely follow the system in use here. A Belgian firm in Shanghai, Messrs. van der Stegen & Company, are the financial agents. Here, then, would appear to be an opportunity that should not be neglected.

For energy and commercial enterprise in that part of the world the Baldwin Locomotive Works, of Philadelphia, Pa., deserve great commendation. After the World's Fair they despatched Capt. W. H. Crawford to Japan, and he succeeded, after a severe trial on the steep Gotemba grade, in the Hakone Mountains, in convincing the Japanese of the superiority of the American over the British engine. Since that time he has sold to the Japanese government and various private railroad companies over 120 locomotives, besides a number to the Russian-Siberian Railroad in Vladivostok. The same company has recently obtained an order from the Chinese government.

This action on the part of the Baldwin Locomotive Works proves conclusively that in China and Japan we can compete with any nation in Europe. In fact, we have the advantage in the time necessary to fill orders, and in cheap transportation. There are at present six steamship companies, with an aggregate of 20 steamers plying between the Pacific Coast and China, calling at Japanese ports. Besides these there are the Perry and Barber lines running from New York through the Suez Canal to Yokohama and calling at Chinese ports. The freight via these lines ranges between \$5 and \$6 per ton.

## The Society of Mechanical Engineers.

The programme of the December meeting of the American Society of Mechanical Engineers shows that at the opening session, Tuesday, Dec. 1, John Fritz will read the president's address on the "Progress in the Manufacture of Iron and Steel in America and the Relations of the Engineer to It." On Wednesday morning these papers are to be presented: "An Historical and Technical Sketch of the origin of the Bessemer Process," by Sir Henry Bessemer; "Ancient Pompeian Boilers," by Wm. T. Bonner; "The Moment of Resistance," by C. V. Kerr; "Work Done Daily by a Refrigerating Plant and Its Cost," by Francis H. Boyer; "Promise and Potency of High Pressure Steam," by R. H. Thurston. The afternoon session will be devoted to addresses in memory of J. F. Holloway.

Thursday morning will be devoted to the following papers: "Experimental Investigation of the Cutting of Bevel Gears with Rotary Cutters," by F. R. Jones and A. L. Goddard; "The Calibration of a Worthington Water Meter," by J. A. Laird; "Contraction and Deflection of Iron Castings," by Francis Schuman; "A 200-foot Gantry Crane," by John W. Seaver; "Washing of Bituminous Coal by the Lubrig Process," by J. V. Schaefer; "Friction H.-P. in Factories," by C. H. Benjamin. In the afternoon these papers will be presented: "Some Special Forms of Mechanical Computers," by Frederick A. Halsey; "Rustless Coatings for Iron and Steel," by M. P. Wood; "A Method of Shop Accounting to Determine Cost," by H. M. Lane; "Tests of Fireproofing Material," by H. de B. Parsons.

Friday's session will be occupied with the following papers: "The Efficiency of the Boiler Grate," by W. W. Christie; "Efficiency of Boiler Heating Surface," by R. S. Hale; "Paper Friction Wheels," by W. F. M. Goss; "Steam Engine Governors," by Frank H. Ball; "Metric vs. the Duodecimal System," by Geo. W. Colles, Jr.; "Aluminum Bronze Seamless Tubing," by Leonard Waldo, and "The Photographing of Machinery," by Leonard Waldo.

## Association of Railway Superintendents of Bridges and Buildings.

At the annual meeting of this Society at Chicago in October, the following officers were elected:

President, James Stannard, Wabash.  
First Vice-President, Walter G. Berg, Lehigh Valley.  
Second Vice-President, Joseph H. Cummin, Long Island.  
Third Vice-President, Aaron S. Markley, Chicago & Eastern Illinois.  
Fourth Vice-President, R. M. Peck, Missouri-Pacific.  
Secretary, S. F. Patterson, Boston and Maine.  
Treasurer, N. W. Thompson, Pittsburgh, Fort Wayne & Chicago.

The following subjects were selected for committee reports to be presented at Denver next year:

1. Methods of Heating Buildings where Three or More Stoves are now Used.

2. The most Suitable Material for Roofs of Buildings of all Kinds.
3. Round-house Construction, including Smoke-Jacks and Ventilators.
4. Care of Iron Bridges after Erection.
5. How to Determine Size and Capacity for Waterways.
6. Protection of Railroad Buildings and other Structures from Fire.
7. Designs for Ice Houses.
8. Best End Construction for Trestles Adjoining Embankments.
9. Bridge Warnings for Low Overhead Structures.
10. Stockyards and Stocksheds, including all Details of Construction.
11. Floor System on Bridges, including Skew Bridges.

#### Trade Catalogues.

[In 1894 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.]

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car-Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

**THE GOUBERT WATER TUBE FEED WATER HEATER.** The Goubert Manufacturing Company, New York. 48 pages. 6 by 9 inches. (Standard size.)

In March, 1895, we noticed and criticised a catalogue which was issued by the above company about that time. The burden of the criticism was that the commendation of the heater came first and the explanation of its construction afterward, and that the latter was inadequate for a full understanding of the apparatus. We have now received a new catalogue issued by the same company which is a model of its kind. It begins with an admirably clear description of "What a Feed Water is." Then the distinction between "open" and "closed" or "pressure heaters" is explained, and the objections to the former pointed out. The construction of the Goubert heater is then fully described and illustrated by sectional views, so that the wayfaring man and his coadjutant may readily understand it. A section is devoted to directions for erecting and running the apparatus, with an excellent wood engraving showing an engine-room and the disposition or location of the engine, heater, separator, steam pump, etc. Another section is on the use of heaters with condensing engines, which is followed by illustrations of several different forms, tables of sizes and price lists, and showing the percentage of fuel saved by heating feed water, and the yearly saving under differing conditions. A list of reference occupying 13 closely printed pages and a description of the Stratton separator complete the volume. It is admirably printed on best coated paper, the engravings could not be better, and altogether it is an example of the best type of this kind of literature.

**WESTINGHOUSE GAS ENGINES.** Manufactured by the Westinghouse Machine Company, Pittsburgh, Pa. 19 pages. 6 by 9 inches. (Standard size.)

This is apparently a sort of introductory volume to a fuller descriptive circular which is now in course of preparation. During the past two years Mr. George Westinghouse, Jr., has been engaged with the aid of the best obtainable engineering talent in developing and improving a form of gas engine which is illustrated and somewhat meagerly described in the publication before us. A large amount of money has been expended in experimental work and in perfecting a gas engine which it is here announced the company is now ready to supply. The general external appearance of the engine is similar to the well-known Westinghouse steam engine, but the description is only of the general features, which are embodied in this new departure. New shops have been built at East Pittsburgh, and the company announce that they have abundant facilities to supply this new type of engine.

**ENGINE AND BOILER CATALOGUE.** Houston, Stanwood & Gamble. Cincinnati, O. 32 pages. 8 by 10 1/4 inches.

This firm in the introduction to their circular say that they manufacture nothing but slide-valve engines, and that with good workmanship and high steam pressure that there is little difference in their economy compared with high-speed automatic engines. In the pamphlet which has been issued the different types of slide-valve engines which the firm manufactures are described with illustrations of details of different parts, reports of performance, etc. A separate section is devoted to flue and tubular boilers, with tables of dimensions, capacity, etc., and an excellent illustrated descrip-

tion of methods of setting boilers, boiler fronts, etc., and also an illustration and description of a coil feed-water heater which they make.

**THE HANCOCK LOCOMOTIVE INSPIRATOR,** manufactured by the Hancock Inspirator Company, 51 Oliver street, Boston, Mass., 1896; 16 pages, 6 by 9 inches (standard size).

In a circular letter accompanying this catalogue the manufacturers state that they designed and placed on the market the first double-tube locomotive boiler feeder, and that their constant aim has been to produce an instrument that in simplicity, durability and efficiency will best meet the severe requirements of locomotive service. As the company's sales of Hancock Inspirators of all kinds has been more than 200,000 in 20 years, it is evident that good design and workmanship has characterized these boiler-feeders. In the present catalogue the company present three styles or types of the Hancock Inspirator, A, B and D, some one of which is interchangeable with any injector of standard manufacture now on the market. An important fact in connection with this statement is that each and every corresponding part of the three types (A, B and D) is identical in design and interchangeable, the only exception being the bodies, which are shaped to suit the different pipe connections, and the connecting rods and overflow cranks. This will readily be recognized as an important advantage in substituting one standard for the different makes of injectors in use and in the matter of economy when repairs may be necessary.

Besides the illustrations of these inspirators and tables of their prices, capacities and pipe connections, there is a good description of the company's patent hose strainer, which is removable for cleaning without disturbing the coupling or any pipe joints; also check-valves and steam-valves for inspirators, and the Hancock ejectors or "lifters."

#### Equipment Notes.

The Illinois Central is asking for bids on 1,000 freight cars.

The Lake Erie & Western will soon order some new locomotives.

The Chicago, Hammond & Western, is in the market for 100 box cars.

The Gulf, Beaumont & Kansas City will soon place orders for 40 box cars.

The order which the Baldwin works received from China was for eight locomotives.

The Mobile & Ohio has ordered six locomotives from the Rogers' Locomotive Works.

The Armour Packing Company of Kansas City is asking bids on 100 refrigerator cars.

The Fall Brook Railway is contemplating the purchase of two passenger locomotives.

The Delaware & Hudson, it is said, will order new cars and locomotives before next March.

The Wells & French Company, Chicago, are building 400 refrigerator cars for Swift & Company.

The Wabash road is in the market for 20 10-wheel locomotives, 15 for freight and five for passenger service.

The Columbus, Hocking Valley & Toledo is reported to have placed an order with the Michigan-Peninsular Car Company for 50 30-ton dump coal cars.

The Haskell & Barker Car Company is reported to have an order for 1,000 box-cars for the Chicago & Northwestern Railroad, and another 1,000 for the Wisconsin Central.

The Mount Vernon Car Manufacturing Company is building 25 refrigerator cars for the Mobile & Ohio. They will be of 60,000 pounds capacity and will be equipped with air-brakes, Gould couplers and Detroit springs.

The Barney & Smith Car Company, of Dayton, O., are completing 10 combination baggage and passenger cars for the B. & O. R. R. They are to be painted royal blue with gold striping, which has been adopted as the standard color of the road.

The Ohio Falls Car Company is building for the Rio Grande, Sierra Madre & Pacific Railway eight coaches, three cabooses and 150 box-cars of 60,000 pounds capacity. All the cars will have air-brakes

and Tower couplers, and the box-cars will also have Winslow roofs and Q. & C. door fastenings.

A contemporary, *Hardwood*, states that a gentleman, the head of one of the largest railroad systems in the country, computes that the railways of the country will require at least 200,000 freight cars in the next two years, of which fully three-fourths will be box-cars. The construction of these cars will consume 600,000,000 feet of lumber.

Some very severe tests have been made with the royal blue tint, which has been characteristic of the Washington and New York trains of the Baltimore & Ohio Railroad. It has been found that this color meets all the requirements, and it is probable that in the near future the entire passenger equipment will be so painted and the B. & O. have a distinctive color for all its trains.

#### The Q & C Pressed Steel Brake-Shoe Key.

The Q & C Company, Western Union Building, Chicago, Ill., have recently acquired all rights to manufacture the pressed steel brake-shoe key, known as "The Drexel," and as the company has every facility for manufacturing them they will carry a large stock and will be able to supply them promptly and at low prices. The key, which is shown herewith, is much lighter than forged keys but it is very strong. It is cheaper than a forging and it conform



exactly to the Master Car Builders' standard in every respect. All the brake-shoe keys of this design are remarkably uniform in size and strength, and in addition to the economy they save the annoyance and trouble of forging such small work in the smithshop. The key is hereafter to be known as "The Q & C." Prices in large or small quantities can be had by writing to the company.

#### The Roberts Water-Tube Boiler.

The Roberts Safety Water Tube Boiler Company was incorporated in 1890, and notwithstanding the business depression that has existed throughout the country during several of the six years of the company's existence, its business has grown steadily and has assumed large proportions. The capital stock of the company is \$250,000, and last month it declared its sixth consecutive annual dividend of 10 per cent. It has built nearly 900 boilers; ranging from those suitable for small launches up to installations of nearly 2,000 horse-power in one vessel. It is claimed that the works of this company are larger than any other plant in the United States devoted exclusively to the construction of marine water tube boilers. The tools are of the most modern type, nearly \$30,000 having been expended in adding to them during the past year.

Although the Roberts Company are the owners of a number of patents on water-tube boilers, they have found that, all things being taken into consideration, the original type gives the best satisfaction, with some slight improvements in its construction and material. With the possible exception of one different type which has since been practically discarded by its manufacturer, the Roberts boiler is the father of all the marine water-tube boilers now being manufactured in this country, and it has attained an enviable reputation throughout the greater part of the civilized world. The original boiler, built by Mr. Roberts in 1879, is still in use, although it was infinitely inferior to anything built at the present day. The Roberts boilers have an excellent record for reliability also, for not one of them has ever killed a man or produced a disastrous explosion.

#### The Falls Hollow Staybolt.

Most of our readers are familiar with the staybolts made by the Falls Hollow Staybolt Company, of Cuyahoga Falls, O. The material employed in their manufacture is the best-hammered charcoal iron, and the company guarantees its product to be the equal if not the superior of any brand, domestic or imported, in the market. The Southern Railway recently tested some of these bolts

and the following is the result obtained, which we take from a facsimile of the report:

Area in square inches.	Elastic limit per square inch.	Ult. tensile strength per square inch.	Elongation in eight inches.	Remarks.
.657	31,600	51,000	31.25%	Fracture fibrous.

The manufacturers recently received from Mr. Barnes, of the Wabash road a letter, in which an excellent tribute to the quality of these staybolts is given. The letter is as follows:

SPRINGFIELD, Ill., Nov. 4, 1896.

Falls Hollow Staybolt Company, Cuyahoga Falls, O.

GENTLEMEN: Specifications of standard Wabash engines have been recently issued, and the proposition is to be in the market for a number of these locomotives.

In these specifications I have enumerated Falls Hollow staybolts, in confidence that they are the best we can buy for the purpose intended.

I bespeak for this company the best bolt you can make. We want the same bolt which you advertise as your standard goods.

Yours truly, J. B. BARNES.  
S. M. P. and M. Wabash Road.

The bolts are made in all sizes from seven-eighth inch to two inches outside diameter, and from one-eighth inch to three-quarter inch inside diameter, depending somewhat upon the outside diameter, though considerable of a choice in the relation between the two diameters is given in the company's list of standard sizes.

The Manufacturers' Advertising Bureau has now been some six months at its new location, 126 Liberty street, New York City, and finds the move from the old-time headquarters at "111" to have been a good one. The present facilities of the Bureau are thoroughly up-to-date, and enable it to care for the large business entrusted to its care to the utmost satisfaction of its clients and with the greatest degree of convenience and dispatch. There is no other concern in the United States quite like the Manufacturers' Advertising Bureau in the business it conducts, which is original and peculiar to itself. Established in 1879 by its present head and proprietor, Mr. Benj. R. Western, who was for some years previously a publisher of trade journals, its purpose is to manage the newspaper work and advertising for firms who have not the time, inclination or experience to conduct this department of their business themselves, and yet wish brought to it the attention it deserves. The Bureau is an authority on trade-journal advertising, to which it has confined its operations almost wholly, and those in need of expert help in this direction will do well to note the fact. A booklet with the title "Advertising for Profit" is published by the concern for gratuitous distribution to manufacturers generally who are desirous of knowing just how it works.

The new plant of the Fox Pressed Steel Company, at Pittsburg is nearing completion, and will soon be ready for operation.

It is reported that the Newport News Ship Building & Dry Dock Company will enlarge some of its shops in the near future.

The Colorado Fuel & Iron Company, Pueblo, Col., are said to have an order for 10,000 tons of steel rails from the Santa Fe Railroad.

A new Pintsch gas plant is being erected at Pittsburgh for the benefit of the E. & O. R. R., which has adopted this light for its passenger trains.

The Bass Foundry & Machine Works, Fort Wayne, Ind., is said to have closed a contract to furnish a large railway system with car wheels to the amount of over \$500,000.

At the recent annual meeting of the stockholders of the Westinghouse Air Brake Company, it was shown that the gross business for the previous year amounted to \$5,947,600 and that the assets are \$2,607,936.

The Rand Drill Company has received orders for compound air compressors for the Great Northern and the Chicago, Rock Island & Pacific. One of their compressors was recently started in the Gladstone shops of the St. Paul & Duluth.

A large barge for the Hartford & New York Transportation Company was launched last month from the Gildersleeve shipyard, Hartford, Conn. It is 190 feet long and 34 feet beam, with a carrying capacity of 1,350 tons on a draft of 11 feet.

The Laidlaw-Dunn-Gordon Company, of Cincinnati, is building three large air compressors for the Baltimore & Ohio road, and a number of steam pumps for the same road. The company also has some good orders from the Illinois Central and the Chesapeake & Ohio roads.

The Harlan & Hollingsworth Company, of Wilmington, Del., have a contract from the Merchants & Miners' Transportation Company, of Baltimore, Md., for a steel steamer for the company's Baltimore and Boston line. The boat is to be a fine one, and of the following dimensions: Length, 293 feet; beam, 42 feet; depth, 34 feet.

The Babcock & Wilcox Company have furnished two boilers to the New Castle, Pa., Electric Railway Company. The Buckeye Engine Company, Salem, O., have built two cross compound engines of 500 horse-power each for the same plant. The Hall Steam Pump Company, of Pittsburg, have furnished the condensers.

During the last few months the Westinghouse Machine Company Pittsburg, Pa. have shipped the following compound engines abroad: To Algeria one 80 horse-power; to Belgium one 330 horse-power, and two 100 horse power; to France one 1,200 horse-power. In addition they have shipped a large number of Standard and Junior engines during the same period.

The Franklin Steel Casting Company, Franklin, Pa., manufacturers of steel casting, have added to their plant a number of buildings, tools, cranes, furnaces, etc., and they now possess one of the largest steel-casting plants in the country. This company manufactures the Lone Star steel coupler. It is prepared to make steel castings of all kinds up to 60,000 pounds weight.

A contract for 25 air compressors and 25 air receivers, of medium and small sizes, has been closed by the Clayton Air Compressor Works, Havemeyer Building, New York, with one company, delivery of the entire order to be made within six months from date. They also report sales of five air compressors of standard pattern during the first week in November, and the indications point to a decided revival of trade in air compressors many orders having been held in abeyance, pending the result of the election.

The Westinghouse Air-Brake Company has completed arrangements for the manufacture of air brakes at Hamilton, Ontario. The buildings of the McKehnie Machine Company, at Hamilton, have been purchased, and application has been made for a Canadian charter for the Westinghouse Manufacturing Company, Limited of Hamilton. The capital stock of the new concern will be \$500,000. The best modern machinery will be installed in the plant. The capacity will be about 1,000 sets of air-brakes a week. The object of locating in Canada is, of course, to avoid paying duty on brakes sold in Canada, which is about 35 per cent., or nearly \$14 per set of brakes. The General Manager of the new works will be George F. Evans; Secretary, Paul Myler; General Superintendent, M. E. Wallace.

Messrs. R. Ulrich and Charles W. Leavitt, Jr., announce that they have entered into co-partnership for carrying on their professional work of landscape architecture and civil engineering, the firm name being Ulrich & Leavitt. They will make a specialty of furnishing surveys, plans and estimates for developing public and private grounds, including irrigation and drainage. Mr. Ulrich has a large and varied experience, having been landscape architect and superintendent for Hotel del Monte Park, Monterey, Cal., and the public parks of Brooklyn, also for the World's Columbian Exposition at Chicago (under Messrs. Olmstead & Eliot). Besides these he has designed and laid out a number of private grounds. Mr. Leavitt has for several years been in charge of the engineering for the improvements at Essex Falls, N. J., and has also been Assistant Engineer in the East Jersey Water Company. The offices of these gentlemen are at 15 Cortlandt street, New York City.

Judge Sage, of the United States Circuit Court for the Southern District of Ohio, last month rendered a decision in the long-drawn-out suit of W. W. Dodge *et al.* vs. Post & Company *et al.* The defendants were held to infringe two claims of a patent on wooden split pulleys, No. 200,462, granted to Dodge & Phillon, which claims read as follows:

"1. A separable pulley whereof, when the meeting ends of the rim are in contact, the meeting faces of the spoke-bar and hub are slightly separated, as described, combined with clamp bolts *G*, whereby said hub is clamped upon the shaft in the manner set forth.

"3. A separable pulley whereof, when the meeting ends of the rim are in contact, the meeting faces of the spoke-bar are slightly separated, and clamp bolts *G*, combined with a separate split thimble interposed between said shaft and pulley, substantially as set forth."

The Dodge Manufacturing Company, Mishawaba, Ind., owns the patent thus sustained.

The Keystone Axle Company expects to start up a new plant for making car axles at Beaver Falls, Pa., on Jan. 1. The process is a new one, the axles being rolled instead of forged, and it is expected that the rolling process will add to the tensile strength of the material. The building, 80 by 200 feet in size, has been put up by the Pennsylvania Bridge Company. Steam will be supplied by six Brownell boilers of 1,200 horse-power. The rolls are being made by Robinson, Rae & Company, of Pittsburg, from designs furnished by J. T. Rowley, of Tyrone, Pa. The rolling process consists of first reducing blooms nine inches square to round bars 5½ inches in diameter. These are cut to the exact length of the axle end, after reheating, they pass through rolls that give them the shape of the finished axle and bring them to exact size, except at the journal and wheel seat, where one-sixteenth inch is allowed for a finish. It is said the axles will go through the shaping rolls at the rate of two per minute. The offices of the company are in the Equitable Building, Baltimore, Md. Mr. D. A. Clark is President; J. T. Rowley, Vice-President; T. R. Torrence, Secretary and Treasurer, and J. Deegan Superintendent.

## Our Directory

OF OFFICIAL CHANGES IN NOVEMBER.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

*Atlanta, Knoxville & Northern*.—This is the reorganized Marietta & North Georgia Railroad, and Mr. Joseph E. McWilliams has been appointed General Manager, with headquarters at Atlanta, Ga. Mr. H. K. McHarg has been chosen President, and Mr. Eugene C. Spaulding, Vice-President.

*Central Railroad of Georgia*.—Mr. John M. Egan has been elected Vice-President, with headquarters at Savannah, Ga.

*Chicago, Rock Island & Pacific*.—Mr. Wm. H. Stocks is appointed Division Master Mechanic of the East Iowa Division, with headquarters at Rock Island, Ill.

*Chicago & Southeastern*.—Mr. W. De Sanno has been appointed Master Mechanic, vice Mr. J. W. Roberts, resigned.

*Cincinnati, Lebanon & Northern*.—Mr. Joseph Wood has been elected President, to succeed Mr. Geo. Hafer, resigned.

*Huntindon and Broad Top Mountain*.—William W. Noble has been appointed Purchasing Agent and Paymaster, vice S. B. Knight, resigned.

*Middle Tennessee & Alabama*.—Mr. Gaunt Crebs has been appointed Receiver.

*New England*.—Mr. J. T. Odell has resigned the position of Second Vice-President.

*New Orleans & Western*.—Mr. W. W. Tomlinson has been appointed Chief Engineer, with headquarters at New Orleans, vice Mr. C. B. Deason, resigned.

*Northern Pacific*.—Mr. Geo. C. Gorham has been elected Vice-President.

*Pennsylvania Lines*.—Mr. Bernard Fitzpatrick, Master Mechanic at Columbus, has been appointed Master Mechanic at Fort Wayne, to succeed W. W. Atterbury. Mr. Thomas F. Butler is transferred from Wellsville, O., to Columbus, O., to succeed Mr. Fitzpatrick. Mr. Geo. P. Sweeley is transferred from Crestline, O., to Wellsville, and Mr. P. F. Smith, Jr., Assistant Master Mechanic at the Fort Wayne shops, is promoted to the position of Master Mechanic at Crestline, O.

*Philadelphia & Reading*.—Mr. Joseph S. Haniss has been chosen Vice-President, and Wm. R. Taylor, Secretary.

*Quincy, Omaha & Kansas City*.—Mr. O. H. Spencer has been appointed Assistant General Manager and is in charge of the purchasing of supplies.

*Southwestern*.—Mr. B. A. Denmark has been elected President, to succeed the late Mr. Baxter.

*Tabor & Northern*.—H. T. Woods has been elected General Manager.

*Vandalia*.—Mr. Volney T. Malott, of Indianapolis, has been appointed Receiver.

# PRESSED STEEL TRUCK FRAMES

AND PRESSED STEEL PARTS FOR CAR AND TRUCK CONSTRUCTION.

**FOX SOLID PRESSED STEEL CO** { **GENERAL OFFICES:** Fisher Building, 281 Dearborn St., Chicago.  
**WORKS:** Joliet, Illinois.

**JAMES S. BRADY**, GENERAL SALES AGENT, HAVEMEYER BUILDING, NEW YORK.

**F. W. DEVOE & CO.'S** **COLORS AND VARNISHES**  
**ARE STANDARDS.**

**THE ROBERTS SAFETY WATER TUBE BOILER.**

500 IN USE for Naval and Marine Purposes.

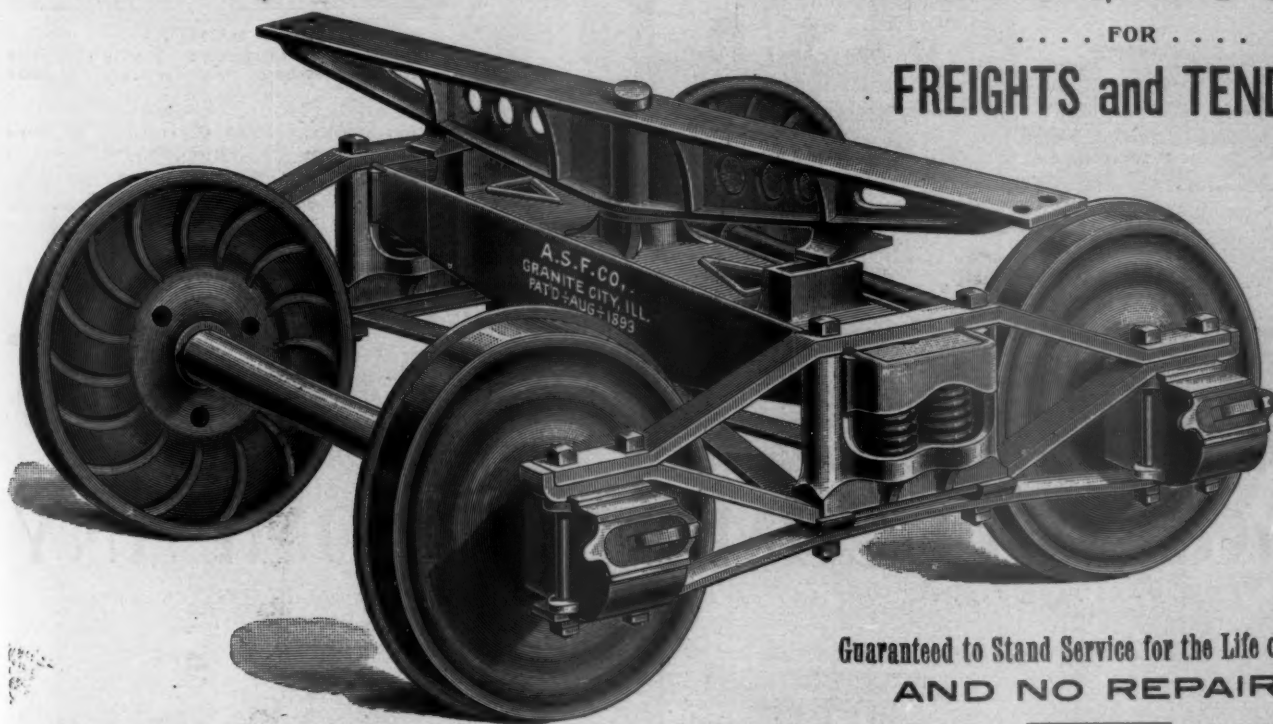
Send for Handsome Illustrated Catalogue.

39 CORTLANDT STREET, NEW YORK.

**THE AMERICAN STEEL TRUCK**

.... FOR ....

**FREIGHTS and TENDERS.**



MADE  
OF  
Soft  
Open-  
Hearth  
Basic  
Steel.

Guaranteed to Stand Service for the Life of the Car  
**AND NO REPAIRS**

**AMERICAN STEEL FOUNDRY CO.,** **ST. LOUIS, MO., U. S. A.**

Send for Descriptive Circular.

**Armstrong Tool Holders.**



For Turning, Planing and Boring Metals.  
**50,000 ALREADY IN USE.**



SEND FOR CATALOGUE.  
**ARMSTRONG BROS. TOOL CO.,**  
No. 98 West Washington St., Chicago.



## BAKER CAR HEATERS

SPECIAL FITTINGS FOR BAKER HEATER WORK.

**FLEXIBLE STEEL FIREPROOF HEATERS**

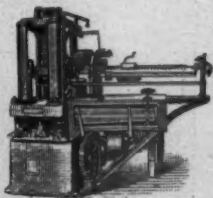
**WILLIAM C. BAKER,**

FIVE OTHER STYLES.

(Successor to Baker Heating Co.)

Single and Double Circulations.

143 LIBERTY ST., NEW YORK.



**OLSEN'S**  
**Testing Machines**

Awarded Medal of Merit at The World's Fair.

**TINIUS OLSEN & CO.,** 500 N. 12th St., Philadelphia, Pa.

FOR TESTING  
Iron Specimens,  
Bridge Materials,  
Chain, Cement,  
Wire Springs, Etc.

Hydraulic Presses,  
Accumulators,  
Gauges & Pumps.

**..STEAM..  
ENGINEERING**  
(Loco., Stat'y. and  
Marine); Electricity;  
Mechanics; Mechanic-  
al and Architectural  
Drawing; Plumbing;  
Architecture; Mining;  
Civil Engineering in  
all Branches.

The International  
Correspondence School



To Steam..  
..Engineers,  
Machinists, Electrical  
Workers, Civil Engi-  
neers, Draughtsmen,  
Steam Fitters, Miners,  
Carpenters, Plumbers.  
References Everywhere.  
Send for Circular.  
State Subject you wish  
to Study,  
Box 945, Scranton, Pa.

**SEND \$3.00** to the  
**AMERICAN ENGINEER,**  
Morse Bldg., New York City,  
for the best book on American  
Cars ever published.

THOMAS PROSSER & SON,  
15 GOLD STREET,  
NEW YORK.  
Old Colony Building, Chicago.

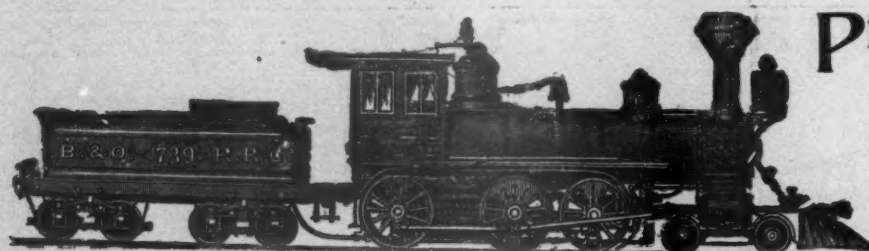


# STEEL TIRES

## On Locomotive Driving Wheels and on Steel-Tired Wheels

GIVE THE BEST RESULTS

FOR EVERY VARIETY OF SERVICE.



### Pittsburgh Locomotive and Car Works,

PITTSBURGH, PA.

Manufacturers LOCOMOTIVE ENGINES for  
of Broad or Narrow Gauge Roads

From standard designs, or according to  
specifications, to suit purchasers.

Tanks, Locomotive or Stationary Boilers  
Furnished at Short Notice.

Wilson Miller, Pres. & Treas.

D. A. Wightman, Supt.



### MANCHESTER LOCOMOTIVE WORKS,

Manufacturers of

## LOCOMOTIVES

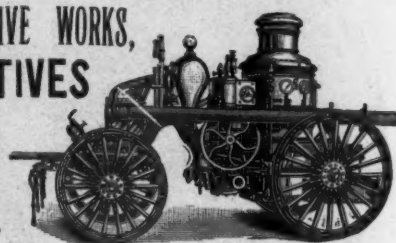
AND THE

### AMOSKEAG STEAM FIRE ENGINE

ISRAEL G. WHITNEY

Treasurer, BOSTON

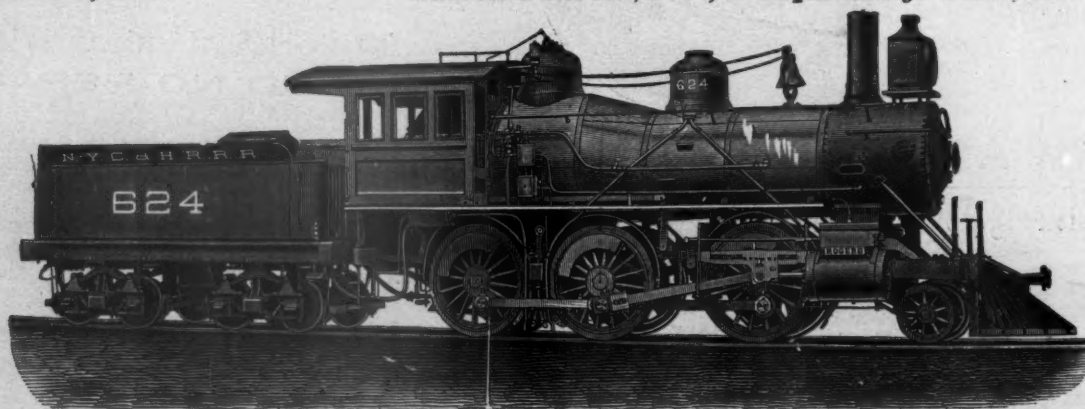
ARETAS BLOOD, Agent,  
Manchester, N. H.



# ROGERS LOCOMOTIVE COMPANY

PATERSON, N. J.

Address Paterson, N. J., or 44 Exchange Place, New York.



## BUILDERS OF LOCOMOTIVE ENGINES AND TENDERS OF EVERY DESCRIPTION

R. S. HUGHES, President.

G. S. LONGBOTTOM, Sec'y.

G. E. HANNAH, Treas.

REUBEN WELLS, Supt.



### SCHENECTADY Locomotive • Works, SCHENECTADY, N. Y.

ESTABLISHED 1848.

Annual Capacity, 450.

EDWARD ELLIS, President.  
WM. D. ELLIS, Vice-Pres. and Treasurer.  
A. J. PITKIN, Superintendent.  
A. P. STRONG, Secretary.

**THE NEW "NATHAN"**

(See Illustration)

And Monitor Injectors for Locomotives.

**"NATHAN"****SIGHT FEED LUBRICATORS.**

For Locomotive Cylinders and Air Brakes.

**STEAM FIRE EXTINGUISHERS**

For Switching and Yard Engines.

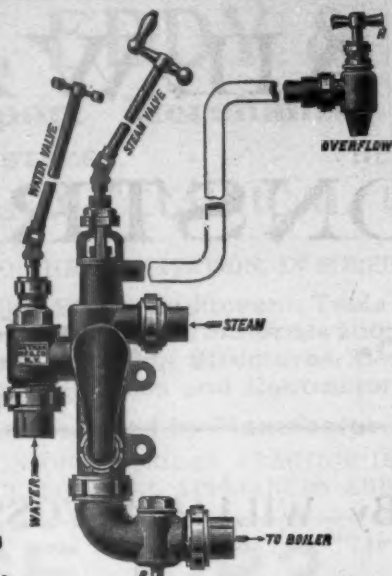
**BOILER WASHERS,**

Rod and Guide Oil Cups, etc.

Send for Descriptive Catalogues

**NATHAN MFG. CO.,**

92 &amp; 94 Liberty St., N. Y.

**PNEUMATIC  
TRACK SANDING  
APPARATUS**

FOR LOCOMOTIVES.

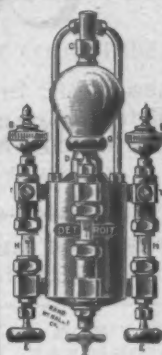
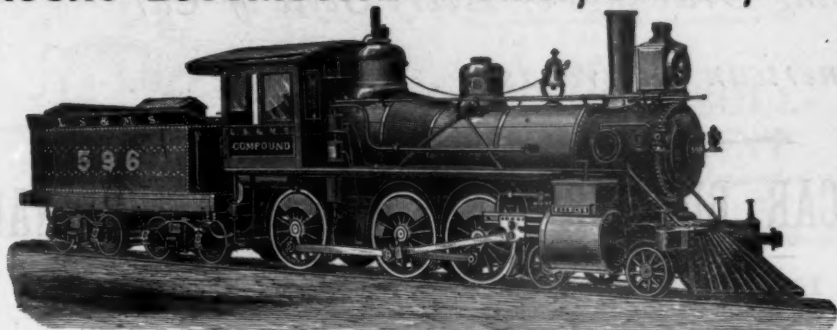
H. L. LEACH, 176 Huron Ave., N. Cambridge, Mass.

The Most Easy Working  
Locomotives  
are those that are  
Equipped with the**DETROIT****SIGHT FEED****LUBRICATORS**

Our Catalogue Tells Why.

Send for it.

DETROIT LUBRICATOR CO., Detroit, Mich.

**BROOKS LOCOMOTIVE WORKS, Dunkirk, N. Y.**

BUILDERS OF LOCOMOTIVE ENGINES FOR ANY DESIRED SERVICE FROM OUR OWN DESIGNS OR THOSE OF PURCHASER. Perfect Interchangeability and all Work fully Guaranteed.

**COMPOUND LOCOMOTIVES**

FOR PASSENGER AND FREIGHT SERVICE.

M. L. HINMAN, Pres. and Treas.

R. J. GROSS, Vice-Pres.

T. M. HEQUEMBOURG, Sec'y.

F. H. STEVENS, Ass't to the Pres't.

DAVID RUSSELL, Supt.

H. TANDY, Asst. Supt.

**Drawing Materials, Surveying Instruments.**

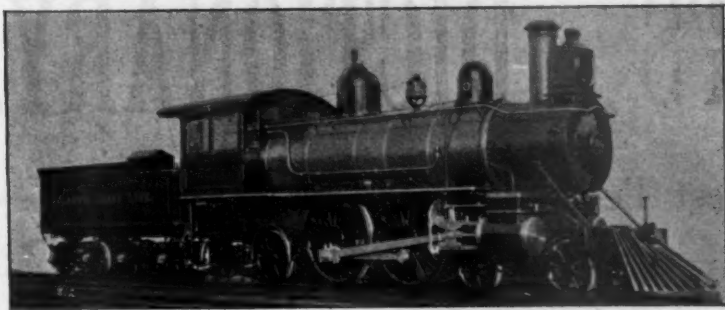
The largest and best-assorted stock in this line. The most complete catalogue. All goods warranted.

Catalogue on Application.

BOUND VOLUMES OF THE

**National Car and Locomotive Builder**

For 1895. Price \$3.

**Baldwin Locomotive Works.**

Established 1831. ANNUAL CAPACITY, 1,000.

**LOCOMOTIVE ENGINES**

Adapted to every variety of service and built accurately to standard gauges and template. Like parts of different engines of same class perfectly interchangeable.

Single Expansion and Compound Locomotives; Electrical Locomotives; Broad and Narrow Gauge Locomotives; Mine Locomotives by Steam or Compressed Air; Plantation Locomotives; Noiseless Motors for Street Railways, Etc.

**BURNHAM, WILLIAMS & CO.,**

Proprietors,

PHILADELPHIA, PA.

ESTABLISHED 1865.

**RICHMOND LOCOMOTIVE & MACHINE WORKS,**

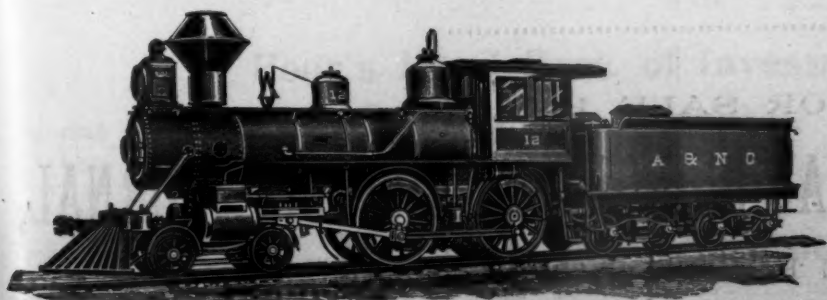
RICHMOND, VA.

BUILDERS OF

**LOCOMOTIVES**

FOR EVERY VARIETY OF SERVICE.

Accurately Made to Gauges and Templates.



---



# RAILWAY CAR CONSTRUCTION.

200 Pages.

500 Engravings.

---

By WILLIAM VOSS.

---

*With Full Working Drawings of Every Style of Car  
Now Used on American Railroads. . . . .*

---

ADDRESS

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL,  
MORSE BUILDING, NEW YORK.


---

... NEW ...

## CAR BUILDER'S DICTIONARY.

The Handsomest and Costliest Technical Book in the World.

*A Liberal Education for a Railroad Officer.*



**PRICE \$5.00.**

Every Car Builder must have it. Necessary for Inspectors at Interchange Points.

.....

FOR SALE BY

AMERICAN ENGINEER, CAR BUILDER & RAILROAD JOURNAL,  
ROOM 60, MORSE BUILDING, NEW YORK CITY.

AGENCIES:  
London.  
Hamburg.  
Rio de Janeiro.  
Valparaiso.

# FLINT, EDDY & CO.,

**Export Merchants,**

66-68 BROAD STREET, - - NEW YORK.

## ENGINEERING AND TECHNICAL DEPARTMENT.

AGENCIES:  
Sydney, Australia.  
Lima, Peru.  
Guayaquil, Ecuador.  
Havana, Cuba.  
Buenos Ayres.

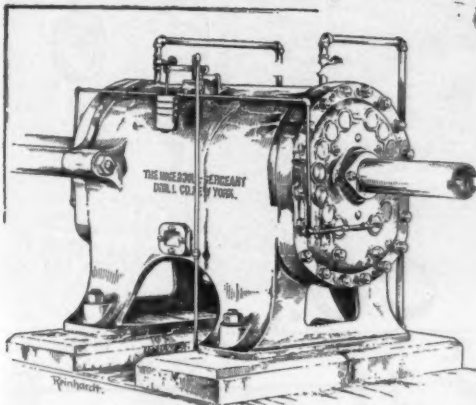
SPECIAL EFFORTS ARE DIRECTED TO THE SOLICITATION, IN FOREIGN COUNTRIES, OF ORDERS FOR  
Railway Constructions, Material, Rolling Stock, Equipment, Tools and Supplies, Electric Tramwa  
Lighting Plants, Electrical Appliances, Tools, Materials and Supplies for Public Works,  
Bridges and other Steel and Iron Structures, General Engineering,  
Equipment and Supplies and Contractors' Outfits.

Are prepared to Finance Orders received by Manufacturers from Foreign Countries.

BOOK OF REFERENCE AND INFORMATION ON AMERICAN PRACTICE IN RAILROADS, PUBLIC WORKS, LAKE  
AND RIVER NAVIGATION, ELECTRICAL APPLIANCES AND SPECIAL INDUSTRIES.

## DO YOU USE AIR?

IF YOU DON'T YOU ARE NOT  
KEEPING UP WITH THE TIMES



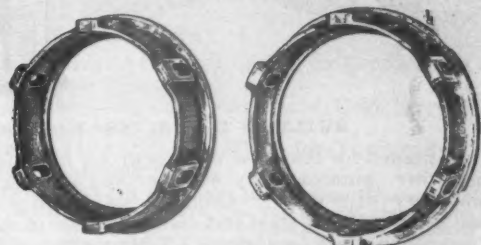
### Air Compressors

OF ...  
THE  
INGERSOLL-  
SERGEANT

make, are the highest type of  
machines.

Air in the Shop  
saves Money.

SEND FOR CATALOGUE. : : :



Valves after 5 years of hard use.



Valve after being under a steam hammer.

The Ingersoll-Sergeant Drill Co., HAVEMEYER BLDG.,  
NEW YORK.

29th ANNUAL  
NUMBER OF ...

# POOR'S MANUAL

... OF THE ...

## Railroads of the United States

STEAM RAILROADS,  
Street Railway and Traction  
Companies.

1896

"Industrial" Corporations,  
National, State and Municipal  
Finances.

In which is incorporated the most valuable features of

## POOR'S DIRECTORY OF RAILWAY OFFICIALS

... AND ...

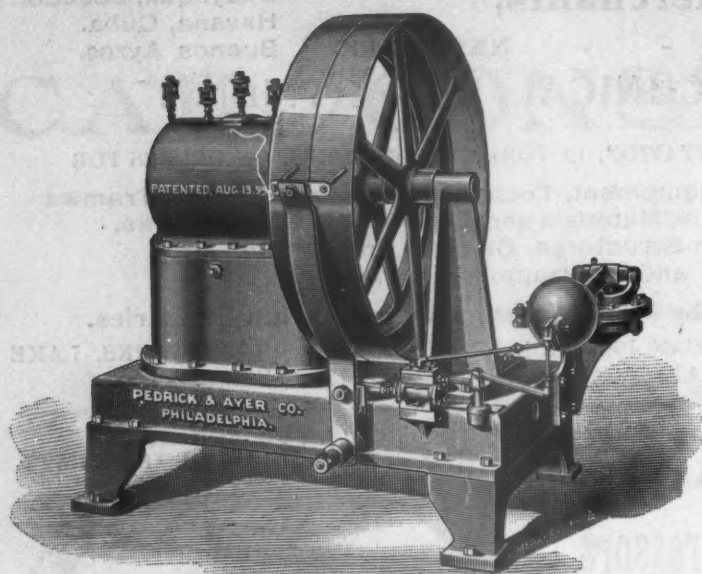
Poor's Hand Book of Investment Securities.

In One Volume, Royal Octavo, Cloth, 1,800 Pages.

PRICE, \$7.50 PER COPY.

H. V. & H. W. POOR, Publishers, 44 Broad St. (Edison Building)  
... NEW YORK. ...

## AUTOMATIC COMPOUND BELT AIR COMPRESSOR.

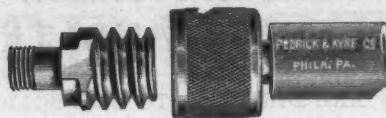


BUILT IN TWO SIZES—Nos. 1 and 2.

Designed for Shop use to furnish Air for Pneumatic Tools. Self-regulating, automatically stopping and starting as pressure varies, using very little power. Occupies small space. As durable as is possible to make of steel and cast iron. 120 in successful operation. If interested write for Form 17 Novelty.

## AIR HOSE COUPLINGS AIR LIFTS.

WITH SELF-CLOSING VALVE.



Made in three sizes— $\frac{1}{4}$ ,  $\frac{1}{2}$  and 1 inch. A very serviceable and quick coupling. When disconnected the flow of air is stopped. A very desirable device for connecting hoists that are to be used in different places, as the load can be raised and disconnected and the hoist or other tool moved away. By having several pendant hose with these fixtures, one hoist will serve in many places.

WRITE FOR FORM NO 13 NOVELTY



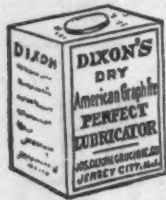
NEW CATALOGUE

JUST ISSUED. . .

Cut represents No. 2  
Built in three styles:  
Nos. 1, 2, 3.  
No. 1 style for ordinary lift  
ing. No. 2 style has load  
retainer and can be ad-  
justed for exact heights.  
No. 3 has an additional  
releasing valve for found-  
ry work. Write for  
Form No. 6 Novelty

## PEDRICK & AYER CO.,

STATION S, PHILADELPHIA, PA., U. S. A.



It has been demonstrated beyond question that

### DIXON'S PURE FLAKE GRAPHITE

Is as necessary to the proper equipment of an engine as a monkey wrench or an oil can. It positively saves engine and valve oil, and prevents and cures hot pins and bearings.

SEND FOR SAMPLE AND TESTIMONY OF EXPERTS.

JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.

# NEW CAR BUILDER'S DICTIONARY.

The Handsomest and Costliest Technical Book in the World.

*A Liberal Education for a Railroad Officer.*

**PRICE \$5.00.**

Every Car Builder must have it. Necessary for Inspectors at Interchange Points

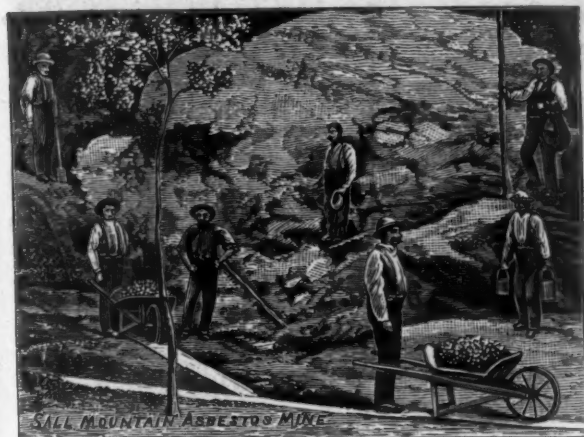
FOR SALE BY

## AMERICAN ENGINEER, CAR BUILDER & RAILROAD JOURNAL.

Room 60, Morse Building, New York City.

# MACK INJECTOR COMPANY,

**BOSTON, MASS.**



## BRUNER, SPRAGUE & COMPANY,

SOLE SELLING AGENTS FOR

### SALL MOUNTAIN ASBESTOS CO.

The Best Material in the World for Fireproofing, Deadening, Insulating, Lagging, Etc.

MASTER MECHANICS OF RAILROADS for Lagging for Locomotives Covering for Boilers and Steam Pipes.

MASTER CAR BUILDERS for Insulating Refrigerator and Cold Storage Cars, Coaches and Sleeping Cars.

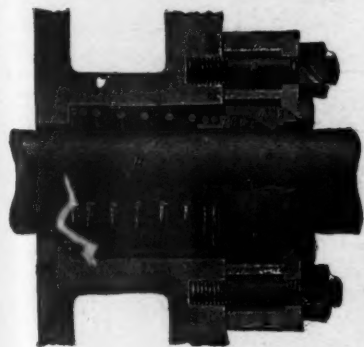
ARCHITECTS, ENGINEERS AND CONTRACTORS for Fireproofing, Insulating Partitions and Deadening Floors.

THE SALL MOUNTAIN ASBESTOS CO. have an Immense Mine of Pure Short Fibre Asbestos, located at Santee, White County, Ga., and we are prepared to furnish it at prices so low that it can be used in direct competition with Mineral Wool and kindred materials; while at the same time it is far superior in quality and durability, and goes much farther according to the weight.

Write for prices and samples to

## BRUNER, SPRAGUE & COMPANY,

Room 1027-8 Manhattan Building, Chicago, Ill.



## U. S. Metallic Packing Co.,

### Metallic Packing

for Locomotives,  
Marine and  
Stationary Engines.

Chouteau Pneumatic Hammer,

Gollmar Locomotive Bell Ringer.

Office and Works: 427 NORTH 13TH STREET, PHILADELPHIA, PA.



THE NEW

# Car \* Builder's \* Dictionary

IS NOW READY FOR DELIVERY.

**5,683 Engravings.** \*

The handsomest and costliest technical book in the world.

A LIBERAL EDUCATION FOR EVERY RAILROAD OFFICER.

Every Car Builder must have it.  
Necessary for Inspectors at Interchange Points.

PRICE \$5.00

WE CAN FILL YOUR ORDER.

AMERICAN ENGINEER, CAR BUILDER and RAILROAD JOURNAL,  
140 NASSAU STREET, NEW YORK.

Coal  
Handling  
Machinery.



Grab-buckets,  
Cable roads,  
Cars and  
Conveyors.

## RAILWAY CAR CONSTRUCTION

The Only Perfect Work on American  
Cars Ever Published.

Written and Compiled by WILLIAM VOSS.  
200 Pages.

Upward of 500 Engravings.

Price, postage prepaid,  
\$3.00 Per Copy.

Remit by Bank Check, Express Money Order,  
P. O. Money Order or Registered Letter.

ADDRESS

AMERICAN ENGINEER,  
CAR BUILDER AND RAILROAD JOURNAL,  
Morse Building, New York.

**BABCOCK & WILCOX BOILERS**

**THE BABCOCK & WILCOX CO.**

29 CORTLANDT ST.  
NEW YORK.

SEND FOR BOOK ON STEAM.

## NEW YORK AND NEW ENGLAND.

THE AIR LINE LIMITED.

NEW YORK AND BOSTON TRAIN.

Leave either city..... 3:00 p. m.

Arr. at termini..... 9:00 p. m.

See That Your Tickets Read via Willimantic.

TICKET OFFICES:

Grand Central Station, New York; 322 Washington Street, Boston. Depot foot of Summer Street, Boston. Runs daily, including Sundays.

DINING AND PARLOR CARS.



# MORISON PROTECTOR FIRE FRONTS AND DOORS

FOR  
LAND and MARINE BOILERS.

—MANUFACTURED BY—

The Continental Iron Works,

P. O. Station G, : Send for Circular. : BROOKLYN, N. Y.



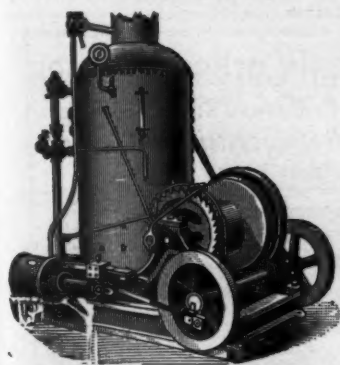
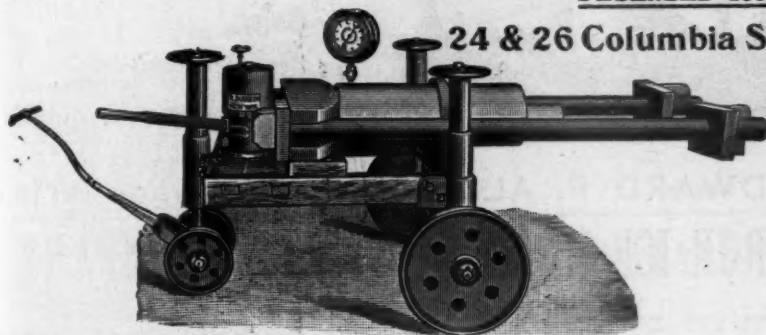
## R. DUDGEON'S IMPROVED HYDRAULIC JACKS

PATENTED 1884.

24 & 26 Columbia St., New York.

**PUNCHES,**  
ROLLER TUBE EXPANDERS  
AND DIRECT-ACTING  
STEAM HAMMERS.  
**JACKS**

For Pressing on Car  
Wheels or Crank Pins  
Communications by let-  
ter will receive  
prompt attention.



THE CONTRACTORS' PLANT MFG. CO.

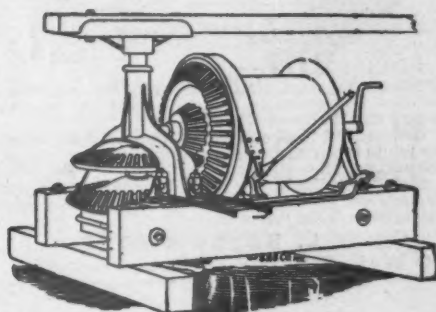
MANUFACTURERS OF

Steam, Horse and Hand Power

**Hoisting Machines,**

DERRICK IRONS AND  
CONTRACTORS' SUPPLIES.

129 ERIE STREET, BUFFALO, N. Y.



## THE WATSON-STILLMAN COMPANY,

204, 206, 208, 210 East 43d Street, New York.

HEADQUARTERS FOR ALL KINDS

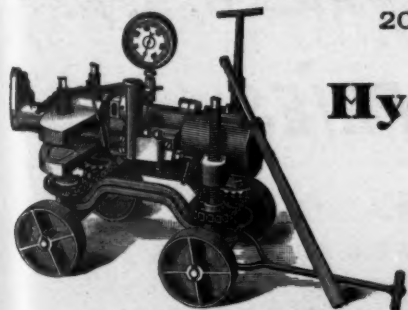
**Hydraulic Tools for Railroads**

**Improved Hydraulic Jacks**

FROM 4 TO 200 TONS.

Presses, Pumps, Accumulators, Valves, Gauges, Fittings, Etc.

Send for Catalogue K.



CRANK PIN PRESS.

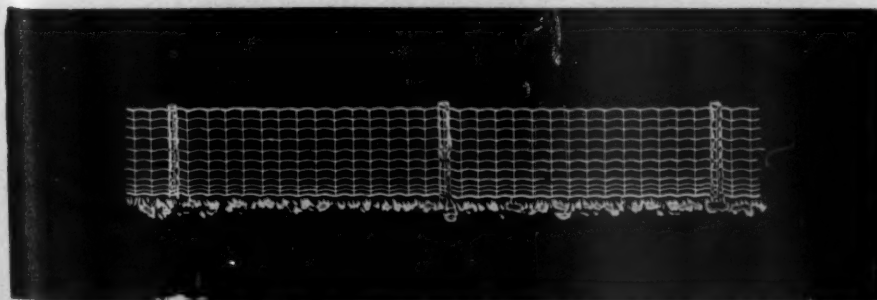


# FIRST

For Farms . .  
For Railroads

Around Parks  
and Cemeteries

**PAGE WOVEN WIRE FENCE CO., Adrian, Mich.**

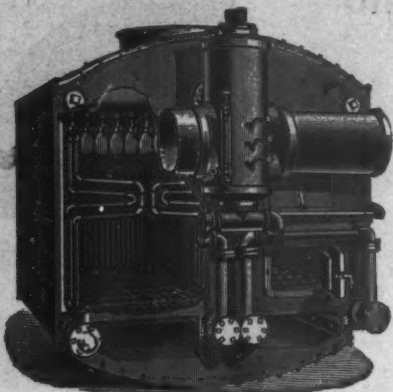


ADVERTISE  
IN  
AND SUB-  
SCRIBE FOR

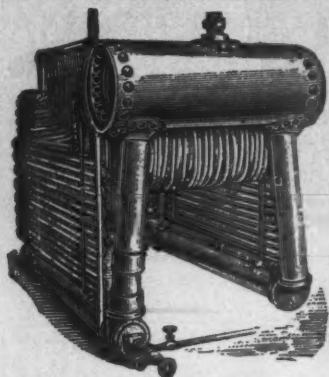
**DIGEST & PHYSICAL TESTS**

FRED'K A. RIEHLE,  
1424 N. 9th St.,  
Philadelphia.

Hydraulic Pumps and Presses, Rob Jacks, Iron Founders  
and Machinists, Riehle Bros.' Testing Machine Co. Store,  
19 N. 6th St., Philadelphia; N. Y. Office, 93 Liberty St.

**ALMY WATER TUBE BOILER**  
Adapted for Stationary or Marine Work.

ALMY WATER TUBE BOILER CO., Providence, R.I.

**BOYER'S  
PATENT  
SECTIONAL  
WATER  
TUBE  
BOILER.**

These rapid steaming Boilers require less room, occupy less space in width, height and length; weigh less than any other.

Have short, perfect circulation, no dead ends, no joints in the fire, and any engineer can get at all parts of it.

The Steam Yacht "Rex," having 25 sq. ft. grate surface and 1,000 sq. ft. heating surface, steamed 144 miles on 1,000 lbs. of coal.

Address **L. BOYER'S SONS,**  
90 Wall St. - New York City.

**MODERN METHODS** Applied to Elevating and Conveying Materials and Transmitting Power.

Machinery designed and erected to suit existing conditions and available space.

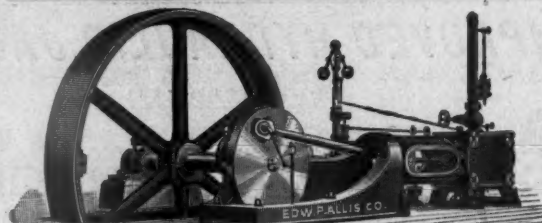
**EWART LINK-BELT, MONOBAR, DODGE, LEY,**

And other Improved Chains with all approved appliances and devices for complete equipments and efficient work.

**LINK-BELT ENGINEERING CO.,**

Nictetown, Philadelphia.

49 Dey St., New York.

**LINK-BELT MACHINERY CO., CHICAGO AND NEW ORLEANS.**

Reynold's Corliss Engines.

Reynold's Patented Vertical Boilers,

Air Compressors,

Special Engines for Street Railways.

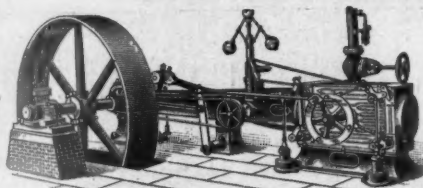
**THE EDWARD P. ALLIS CO., Milwaukee, Wis.****NEWBURGH ICE MACHINE & ENGINE COMPANY,**

SUCCESSORS TO

**WHITEHILL ENGINE & PICTET ICE MACHINE CO.**Office and Works: **NEWBURGH, N. Y.**

NEW YORK OFFICE:

TAYLOR BLDG., ROOM 44, 39-41 CORTLANDT ST.

**Whitehill Corliss Engines**Simple, Compound and Condensing  
Ice and Refrigerating Machinery,  
Iron and Brass Castings.**COMBINE SAFETY WATER TUBE BOILER****L.M. MOYES, MANUFACTURER, PHILADELPHIA, PA.****J. G. BRILL CO., PHILADELPHIA, PA., U. S. A.****STREET RAILWAY SUPPLIES.****CARS TRUCKS.****WE MAKE**Ratchet Handles, Track Scrapers,  
Tiller Brakes, Lever Brakes,

Gates, Sand Boxes,

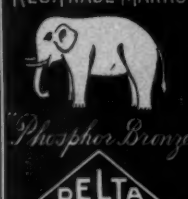
Drawbars, Drop Drawbars.



.....

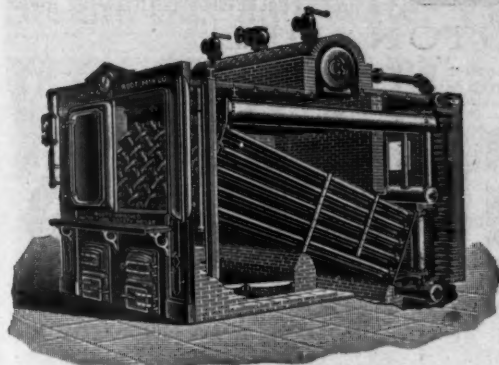
We can furnish anything used on a street railway at low prices.

REG. TRADE MARKS



THE PHOSPHOR BRONZE SMELTING CO. LIMITED,  
2200 WASHINGTON AVE., PHILADELPHIA.  
"ELEPHANT BRAND PHOSPHOR-BRONZE"  
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.  
— DELTA METAL —  
CASTINGS, STAMPINGS AND FORGINGS  
ORIGINAL AND SOLE MAKERS IN THE U.S.

## ROOT IMPROVED WATER TUBE BOILER.



SELLING AGENTS:

Neave Building, Cincinnati, O.  
Security Building, St. Louis, Mo.  
Monadnock Block, Chicago, Ill

ABENDROTH & ROOT MFG. CO.,  
28 Cliff Street,  
NEW YORK

## CAMERON STEAM PUMP



## REVISED POCKET GEOLOGIST

AND . . .

MINERALOGIST.

OR . . .

SIXTEEN PRACTICAL CHAPTERS.

By FREDERICK H. SMITH, Engineer and Geologist.

212 Pages. Cloth Bound. Pocket and Flap. Price, \$1.00.

— SENT BY MAIL, ON RECEIPT OF PRICE, BY —

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL, 140 Nassau St., New York.



## THE BOYER RAILWAY SPEED RECORDER

The only Recorder made that gives a chart of the run that can be read at sight, and has a DIAL INDICATOR carried into the CAB so Engineer can see at a glance, any time, what speed he is running.

Boyer Railway Speed Recorder Co.,

244 DICKSON STREET,

ST. LOUIS, MO., U.S.A.

SAVES 10% TO 50% FUEL  
AMERICAN HEAT INSULATING CO.  
PITTSBURGH, PA.  
PIPE & BOILER COVERINGS  
INCREASES CAPACITY OF STEAM PLANT

Mineral Wool, Asbestos Goods, Insulating Materials of all Kinds.

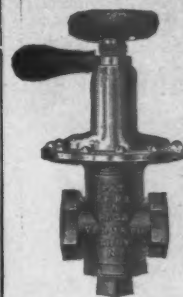
## ROBERTS PATENT Woven Wire Car Seats, RATTAN and PLUSH SEATS.

Patent Woven Wire Seats and Back Springs.

Address for Catalogue, Estimates, etc.,

THE HARTFORD WOVEN WIRE MATTRESS COMPANY,  
P. O. Box 363, Hartford, Conn.

## ROSS VALVE CO.,



Oakwood Ave., Troy, N. Y.

Manufacturers of

Ross Pat. Press-Regulators

For Water, Steam or Air.

Ross Water Engines

For Pumping Church Organs

Send for Circulars.

## GALENA OIL WORKS, Limited.

GALENA ENGINE, COACH AND CAR OILS, THE STANDARD LUBRICATING OILS OF AMERICA.

Safety, speed and economy are the results of the use of Galena Oils. Cold test, 10° to 15° below zero. These oils do not freeze in the coldest weather, while they are adaptable to the hottest climates.

In the use of Galena Oils there is an entire freedom from hot boxes, except when these are caused by mechanical defects.

Galena Oils are in exclusive use upon three continuous lines of railway from Boston and New York to the Pacific Coast, and upon one continuous line from the City of Mexico to New York, thus demonstrating their adaptability to all temperatures and climates. Being entirely free from gum, these oils are not affected by dust and sand, as are other oils.

We furnish our patrons Sibley's Perfection Valve Oil, which is also used exclusively upon a majority of the leading railways of this country.

Galena Oil Works, Limited.

CHARLES MILLER, President, Franklin, Pa.  
Chicago Branch Office,  
Phenix Building, 138 Jackson Street.



**CROSBY POP SAFETY VALVES**  
MUFFLED and PLAIN.  
IMPROVED  
**Steam Gages.**  
Single Bell  
Chime Whistles.  
All Standard Goods.  
Specify these and thus secure a perfect equipment for a locomotive.  
**PATENT GAGE TESTER.**  
**CROSBY**  
Steam Gage Valve Co.  
Boston, Mass.  
BRANCHES:  
New York, Chicago and London.

## DEANE'S PATENT ADJUSTABLE T-SQUARES.

"Limited," "Unlimited" Climax.  
BEST T-SQUARES MADE.  
For sale by dealers in all the principal cities. Circulars on application. Samples by mail postpaid. 24-inch Limited Adjustment, Nickel Trimmings, \$1.  
24-inch Unlimited Adjustment, Nickel Trimmings, \$1.50  
E. L. DEANE, SOLE MFR., HOLYOKE, MASS



**MACHINERY**

**FOR SALE—CHEAP FOR CASH.**  
Hoisting Engines, Air Compressors, Rock Drills, Rock Crushers, Dump Cars, Channeling Machines, Steam Pumps, Steam Shovels, Light Locomotives, etc., all in good condition.

**WILLIS SHAW,**  
506 N. Y. Life Building, CHICAGO.

**SOOYSMITH & CO.,**

INCORPORATED,

Contracting & Engineers,

Mills Bldg., 15 Broad St., New York

**THE LEHIGH VALLEY**

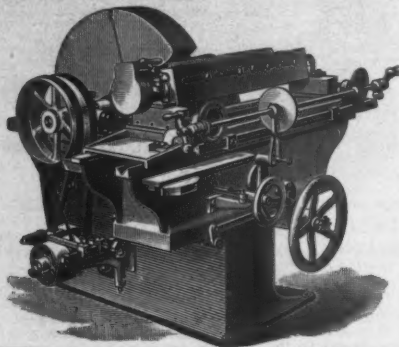
**CREOSOTING • WORKS.**

**OFFICE:** Rooms 136 and 137 Washington Bldg., No. 1 BROADWAY, NEW YORK.

**WORKS:** PERTH AMBOY, N. J.

ROLLIN H. WILBUR, Pres.

WALTER G. HERG, Engineer. H. COMER, Supt. Lumber, Piling and Ties creosoted with **DEAD OIL OF COAL TAR.** Creosoted timber furnished. Capacity, 400,000 ft. B. M. per month. Cylinders, 80 ft. long. Direct water and rail communication.

**BRIDGEPORT SAFETY EMERY WHEEL CO.**

Patentees and Manufacturers

Emery Wheels and Emery Wheel Machinery  
**BRIDGEPORT, CONN.**

**LEONARD & ELLIS.**

TRADE MARK.

**VALVOLINE**

**OILS FOR RAILROADS.**

**VALVOLINE OIL** has long been used on many of the leading railroads in this country and abroad. It has no equal in quality and mileage.

**W. A. BOYDEN, Gen'l Agent,**  
137 CHAMBERS ST., NEW YORK.

**RAILWAY : CAR : CONSTRUCTION**

200 Pages. 500 Engravings.

By **WILLIAM VOSS.**

With Full Working Drawings of  
Every Style of Car Now Used on  
American Railroads.

ADDRESS . . .

American Engineer, Car Builder  
and Railroad Journal,

Morse Building, New York.

**DELAWARE CAR WORKS**

**JACKSON & SHARP COMPANY.**

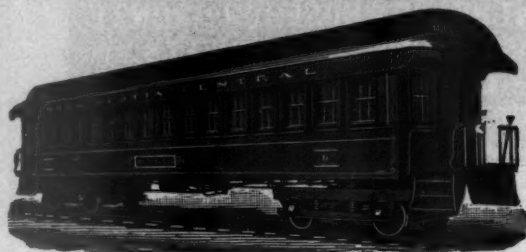
MANUFACTURERS OF

PASSENGER,

SLEEPING, CITY

BAGGAGE and

FREIGHT CARS.



**WILMINGTON, DEL.**

able address "**Jackson.**" Special attention given to Sectional Work for exportation and narrow gauge cars.

**PASSENGER CARS**

of the finest finish, as well as every description of  
**CAR WORK** furnished at short notice and at  
reasonable prices by the . . . . .

**HARLAN & HOLLINGSWORTH COMPANY**

**WILMINGTON, DEL.**

**The Jackson & Woodin Mfg. Co.,**

**BERWICK PA.**



**FREIGHT CARS, CAR WHEELS, CAST IRON WATER AND GAS  
PIPE, CASTINGS and FORGINGS.**

**FRED. H. EATON, President.**  
**H. F. GLENN, General Manager.**

**W. H. WOODIN, Vice-President.**  
**WM. F. LOWRY, Secretary and Treasurer.**

**THE BOIES STEEL WHEEL COMPANY,**

—MAKERS OF—

**Steel-Tired Wheels**

—WITH—

**WROUGHT IRON CENTERS,**

For Every Class of Service.

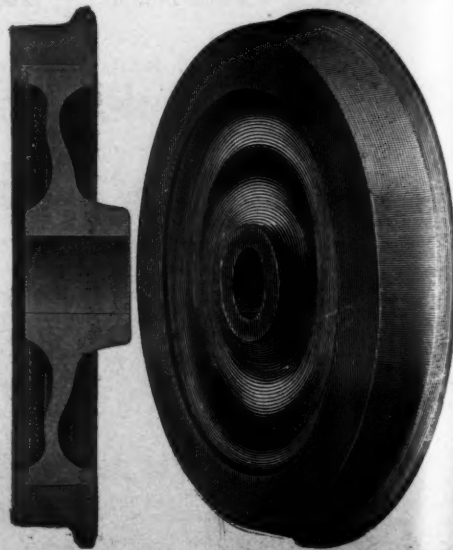
—O—

**SCRANTON, PA.**

—O—

If you want absolutely the best wheels under  
your equipment, buy the Boies for renewals, or  
insert "Boies Wheels" in your specifications.

There is but one best wheel on the market,  
we make it. We will demonstrate this to  
your entire satisfaction, either by tests at our  
Works, or in service on your own Lines, if you  
will give us the opportunity.



# THE ALLISON MFG. CO , PHILADELPHIA, PA.

## Railroad Freight Cars.

## AMERICAN CHARCOAL IRON BOILER TUBES.

## Steam, Gas and Water Pipe and Pipe Fittings.

# KRUPP'S No. 1 WHEEL



*Patent Wrought Iron Coil Disc  
Center Fitted with Steel Tire  
and Retaining Rings.*

This wheel is no experiment, there being over 150,000 in use, and after a thorough test it has been demonstrated that it is the best, safest and most economical wheel in the market. The center is made by taking a strip of iron, wider at the ends, and coiling it around a mandril and then forging it into shape by means of hydraulic dies, so that all centers of a given size are interchangeable and indestructible and can be re-tired in any railroad shop, and it is the only wheel in the market the center of which is made of ONE piece of wrought iron.

Parties intending ordering rolling stock would do well to insert in their specifications that

KRUPP'S No. 1 Wheel be used, and thereby obtain a wheel which will give satisfaction.

Send for our Steel-Tired Wheel Catalogue, showing other styles of wheels.

## Thomas Prosser & Son, 15 Gold St., OLD COLONY BUILDING, CHICAGO. NEW YORK.

## BRADLEY CAR WORKS, WORCESTER, MASS

ESTABLISHED 1833.

MANUFACTURERS OF EVERY DESCRIPTION OF

## RAILWAY CARS.

OSGOOD BRADLEY & SONS, Proprietors.

## CARLISLE MANUFACTURING CO.,

MANUFACTURERS OF

FREIGHT CARS, BOX, STOCK, GONDOLA, IRON HOP-  
PER, COAL and MINING CARS,  
ENGINES and MILL MACHINERY.  
CARLISLE, PA.

## Pennsylvania Steel Co. STEELTON, PA.

## STEEL RAILS all weights and patterns SPLICES and Fastenings.

Steel Rail Frogs and Crossings,  
Switches, Magneto Alarm Signals  
or Crossings, Semaphores. . . .

Philadelphia Office, | N. Y. Office, | Boston Office,  
208 So. 4th St. | No. 2 Wall St. | 70 Kilby St.

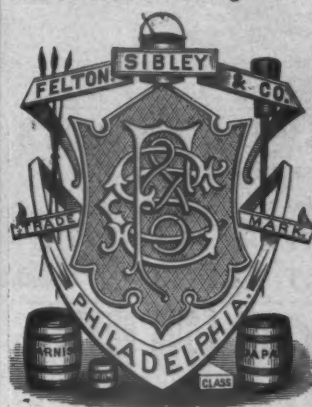
## Non-Corrosive Priming and Finishing Paint

For Engines,  
Machinery, etc.  
This paint being  
entirely free from  
acid will not corro-  
de or rust the  
iron.

Patent Iron Filler  
For Tools,  
Machinery, En-  
gines, Locomo-  
tives, Tenders,  
Iron Ships, and  
all Iron Work  
for Buildings,  
inside or out.

Pure Oxide Paints  
For Bridges and  
General Con-  
struction Work.  
Send for sample  
cards and prices.

Felton, Sibley  
& Co.,  
Philadelphia, Pa.



## WASHINGTON PATENT AGENCY,

908-914 G St., N. W., WASHINGTON, D. C.

—ADVICE FREE.—

FRANK P. CADY,  
Pres. and Supt.

GEO. H. BOWLER,  
Sec'y and Treas.

## THE CADY MFG. CO.,

18-20-22 Johnson St., Cleveland, O.  
POWER PRESSES, DROP HAMMERS,  
Automatic Wire Forming Machinery.  
DIES, SPECIAL MACHINERY.

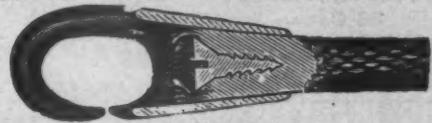


Manufacturers of Set, Cap and  
Machine Screws, Studs, Etc.

## SOLID BRAIDED BELL CORD PLAIN AND FANCY COLORS



## BELL-CORD COUPLINGS.



MANUFACTURED BY  
SILVER LAKE CO.  
HENRY W. WELLINGTON, Agent, BOSTON.

# BILLMEYER & SMALL CO., PASSENGER AND FREIGHT CARS.

## EXPORT WORK A SPECIALTY

—YORK, PENNSYLVANIA, U. S. A.



HOISTING, mining, bridge erecting, dock building, pile driving, coal hoisting and quarry engines of any power, sugar cane transferring engines, transferring machines for depositing cane from car to carrier, with my improved patent friction drums, with or without boilers. Any amount of reference given. Established in 1870. Send for Catalogue.

**J. S. MUNDY,**

Newark, N. J.

1744 Market St., Philadelphia, Pa.; 22 Light St., Baltimore, Md.; 117 Water St., Pittsburgh, Pa.; 249 South Jefferson St., Chicago, Ill.; 75 North Second St., St. Louis, Mo.; 20 Magazine St., New Orleans, La.; 24 Fremont St., San Francisco, Cal.; 59 Front St., Portland, Ore.; 215 Congress St., Boston, Mass.

## HOWARD IRON WORKS

BUFFALO, N. Y.

—: Manufacturers of:—

### SCHLENKERS' AUTOMATIC BOLT CUTTERS.



### BIG FOUR ROUTE

—TO—  
WESTERN and SOUTHERN  
POINTS.

Through Sleeping Cars from  
New York and Boston to Cincinnati, Indianapolis and St. Louis

—VIA—

Boston & Albany R. R., New York Central to Buffalo, L. S. & M. S. Ry. to Cleveland, Big Four Route to Destination.

### ELEGANT CONNECTIONS

With all Trunk Lines in New York and New England. Ask for Tickets via BIG FOUR ROUTE.

**E. O. McCORMICK,** **D. B. MARTIN,**  
Pass. Traffic Manager. Gen'l Pass. & Tkt. Agt.  
BIG FOUR ROUTE, CINCINNATI, O.

Important to Railroad Managers  
and Master Mechanics.

### SIBLEY'S PERFECTION VALVE OIL.

More perfect lubrication insured, and entire freedom guaranteed from corrosion of cylinders and destruction of steam joints by fatty acids.

In exclusive use on 50 railroads.

References and prices furnished upon application.

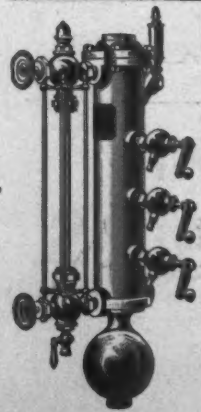
Make exclusive specialty of the Manufacture of Valve and Signal Oils for Railroad use.

**SIGNAL OIL WORKS,**  
FRANKLIN, PA.

**J. C. SIBLEY, President.**

ESTABLISHED 1854.

**CHARLES F. KETCHAM & CO.**  
RAILROAD PRINTERS,  
STATIONERS, ENGRAVERS,  
28 CEDAR STREET NEW YORK,  
SOLICIT YOUR ORDERS FOR ANNUAL OR TRIP  
PASSES FOR 1897.  
SEND FOR SAMPLES AND PRICES.



Boilers Last Longer  
Fuel Goes Further,  
Repairs are Less,  
and Life is Safer,

WHERE

**RELIANCE SAFETY  
WATER COLUMNS  
ARE USED.**

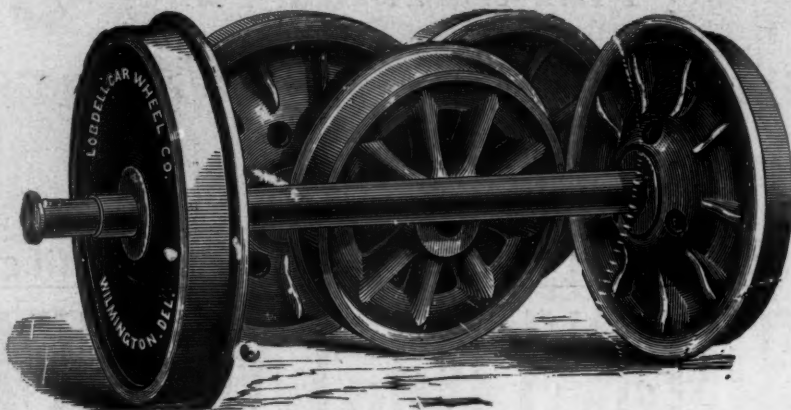
Only Award at the World's Fair.  
Sent on Trial Subject to  
Satisfaction.

They should be included in all  
boiler specifications in the interest  
alike of economy and safety.  
WRITE FOR CATALOGUE.

**The Reliance Gauge Co.**  
73 to 83 East Prospect Street,  
CLEVELAND, O.

## LOBDELL CAR WHEEL CO.,

WILMINGTON,  
DEL.



Single and Double Plate and Solid Spoke Wheels for Steam Roads. Also, Solid and Open Plate Wheels for Street Roads.

**W. M. W. LOBDELL,**  
President.

**GEO. G. LOBDELL, JR.,**  
Vice-President.

**A. McLEOD,**  
Secretary.

**CHAS. F. WOLLASTON,**  
Treasurer.



SECTION OF  
BOLTED, FASTENED.

## RAMAPO WHEEL & FOUNDRY CO.,

RAMAPO, N. Y.

MANUFACTURE

**SNOW'S BOLTLESS STEEL-TIRED CAR WHEELS.**  
**CHILLED WHEELS** in Hollister Non-expanding Chillers.  
**CONGDON BRAKE SHOES,** effecting economy and long service.

### CYLINDER PACKING RINGS

And other high-grade Castings from Special Metal.



## RAMAPO IRON WORKS, Hillburn, N. Y.

MANUFACTURE

### ROSS' AND ROSS-MEEHAN BRAKE SHOES

For Steel-Tired Car and Driving Wheels.

Switches, Crossings, Frogs and Automatic Stands.

RAILROAD CASTINGS.

PLANTATION CARS

ESTABLISHED 1851.

## Catechism of the Locomotive.

For seventeen years it has been the best authority and almost a necessity to every Locomotive Engineer and Fireman, and on many railroads it is the standard for examination of Firemen for promotion.

**Price, \$3.50**

For Sale by . . . . .

American Engineer, Car Builder and Railroad Journal,  
MORSE BUILDING, NEW YORK CITY.

## LATROBE STEEL COMPANY,

. . . MANUFACTURERS OF . . .

# TIRES

FOR LOCOMOTIVE AND CAR WHEELS.

WORKS: LATROBE, PA.

Automatic Steel COUPLERS, Elliptic and Spiral SPRINGS and Steel CASTINGS

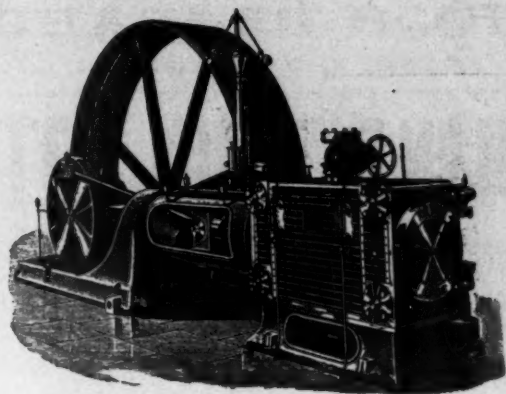
—MANUFACTURED AT—

WORKS, MELROSE PARK, ILL.

MAIN OFFICE: 1300 Girard Building, Philadelphia.

BRANCH OFFICES: Old Colony Building, Chicago; 33 Wall Street, New York;  
Union Trust Building, St. Louis.

# THE BASS FOUNDRIES.



LOCATED AT  
FORT WAYNE, IND.

J. H. BASS, President.  
J. I. WHITE, Secretary.  
R. J. FISHER, Treasurer.

## BASS FOUNDRY and MACHINE WORKS

Manufacturers of . . . **CAR WHEELS and AXLES**

For Freight, Passenger, Electric and Cable Cars.  
Patent "Cushion" Steel-Tired Car Wheels.

RAILROAD CASTINGS and IRON and STEEL FORGINGS.

Improved Corliss Engines, Tubular & Locomotive Boilers.

Main Office and Works: Fort Wayne, Ind. New York Office: 39-41 Cortlandt St.

ST. LOUIS, MO.

J. H. BASS, President.  
J. I. WHITE, Vice-President.  
R. W. GREEN, Secretary.  
J. M. DUTRO, Treasurer.

## ST. LOUIS CAR WHEEL CO.,

. . . Manufacturers of All Kinds of . . .

**Chilled Wheels and Castings.**

General Office and Works: Cabanne St. & Mo. Pac. Ry.

CITY OFFICE:

607-608 Bank of Commerce Bldg., Broadway & Olive St., St. Louis, Mo.

LENOIR CITY, Tenn.

J. H. BASS, President.  
J. I. WHITE, Secretary.  
F. S. LIGHTFOOT, Treasurer.

## LENOIR FOUNDRY COMPANY,

. . . MANUFACTURERS OF . . .

CHILLED WHEELS of superior quality for  
Locomotives, Passenger, Freight and Mining Cars.

Car and Locomotive Castings and General Foundry Work.

Office and Works: LENOIR CITY, TENN.

CHICAGO, ILL.

A. WALLACE, Superintendent.

## J. H. BASS,

. . . MANUFACTURER OF . . .

Car, Engine, Tender, Truck and Driving Wheels.  
Cylinders, Railroad and General Castings.

Office: 707 The Rookery.

Works: Near C. R. I. & P. R. R. Shops, CHICAGO, ILL

# BEMENT, MILES & CO.,

PHILADELPHIA, PA.,

MANUFACTURERS OF

## METAL-WORKING MACHINE TOOLS

FOR

Railroad Shops, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.

## STEAM HAMMERS.

## STEAM AND HYDRAULIC RIVETING MACHINES

New York Office, Taylor Bldg., No. 39 Cortlandt St.

Chicago Office, 1534 Marquette Bldg.

# THE LENOIR CAR COMPANY,

LENOIR CITY, TENN.,

MANUFACTURERS OF ALL CLASSES OF

## FREIGHT AND MINING CARS,

WHEELS, FORGINGS, BOLTS, ETC.

## THE TOWER COUPLER

The most perfect M. C. B. Coupler in all mechanical requirements. The knuckle is thrown open by the lock itself in a positive manner, without the use of springs, gravity, or any extra part whatever. The knuckle is thoroughly interlocked, so that it will pull the train even with the pivot pin entirely removed.

It can never fail to couple either at slow or fast impact. The lock cannot be bent, broken or otherwise disabled or rendered inoperative. In case of failure of draft rigging or breaking of the shank, it promptly uncouples and remains on the car, thus absolutely preventing that class of accidents which result from couplers falling on the track.

### ADOPTED AS STANDARD

by important roads in different parts of the country, and in use in large quantity on about 25 other roads and private lines.

Perfect protection guaranteed against patent suits. Our four great works with their unrivaled capacity, insure prompt delivery as well as the best material and workmanship.

Works:

CLEVELAND, CHICAGO,  
INDIANAPOLIS, TOLEDO.

## Malleable Iron Castings

### For Railroad Use.

The use of malleable iron in car construction, gives increased strength while lessening the weight from 40 to 50 per cent. The constantly increasing size and weight of cars render this subject of the greatest importance. In no other way can so great saving in dead weight be effected at so small cost.

Correspondence on this subject is invited, and sample castings will be furnished to railroads interested.

### LEADING SPECIALTIES:

The Eubank Car Door.  
The National Car Door Fastener,  
The National Journal Box,  
The National Center Plate,  
The National Journal Box-Lid,  
Coffin's Carline, Sill and Brake Block Pockets.

The long and varied experience of this company in designing malleable iron parts, insures the best possible results to our customers.

RAILWAY DEPARTMENT

## NATIONAL MALLEABLE CASTINGS CO.,

1525 Old Colony Building, Chicago.

## **"IMPROVED ENGINE SPRINGS."**

EVERY SPRING GUARANTEED.

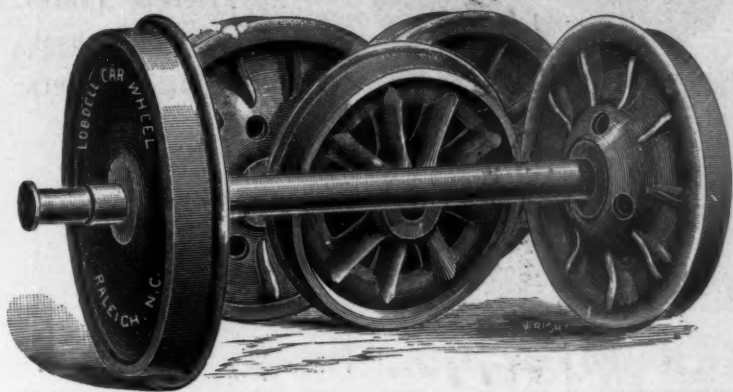
SEND FOR ILLUSTRATED CIRCULAR.

**CHARLES SCOTT SPRING CO., PHILADELPHIA.**

1421 Monadnock Block, CHICAGO.

1417 Union Trust Building, ST. LOUIS, MO.

## **THE NORTH CAROLINA CAR COMPANY,**



—MANUFACTURERS OF—

Gondolas, Box, Flat and  
Stock Cars, Coal Hoppers  
and Lumber Trucks.

—MANUFACTURERS OF—

**LOBDELL CAR WHEELS.**

Car Wheels and Axles for Every  
Description of Railroad Cars  
and Castings for same.



RALEIGH, NORTH CAROLINA.

## **THE SAFETY CAR HEATING & LIGHTING CO.**

160 BROADWAY, NEW YORK.

Railroad Car and Marine Buoy Lighting—PINTSCH SYSTEM.

**CAR AND BUOY LIGHTING.**

This Company controls in the United States the celebrated Pintsch system of Car and Buoy Lighting. It is economical, safe, efficient and approved by Railway Managers and the Lighthouse Board of the United States, and has received the highest awards for excellence at the World's Expositions at Moscow, Vienna, St. Petersburg, London, Berlin, Paris, Chicago and Atlanta. Seventy thousand cars, three thousand two hundred locomotives, and four hundred and sixty buoys are equipped with this light.

**CAR HEATING SYSTEMS BY STEAM.**

The superior steam jacket system, universally used in connection with the Baker Heater.  
The Direct Steam Regulating System.  
Automatic Steam Couplers.

Highest Award World's Expositions at Chicago, 1893, and Atlanta, 1895, for excellence of design and good efficiency.

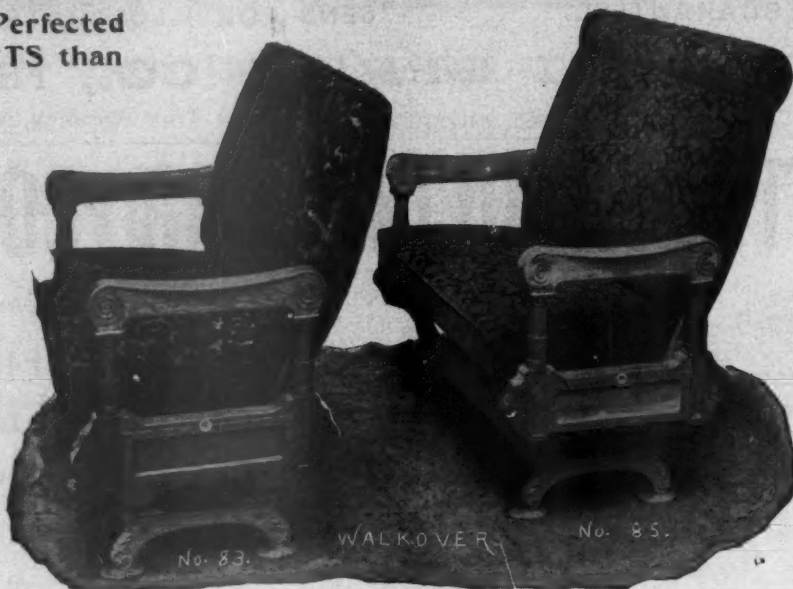
# THE SUPERB "WALK-OVER" CAR SEAT.

As Simplified and Perfected  
HAS FEWER PARTS than  
any other Seat.

*Mechanical Experts  
Pronounce It*

Strongest and Most  
Rigid,  
Finest in appearance,  
Easiest to operate,  
Simplest in construc-  
tion,  
Neatest and best  
every way.

BOTH ENDS  
LOCKED  
AUTOMATICALLY.



*Fast being adopted by*

LEADING  
RAILROADS.

No striker arms,  
No Levers,  
No Friction Plates,  
No twisting of back,  
No lifting in revers-  
ing.

WORKING  
MOVEMENT  
ENTIRELY  
CONCEALED.

MADE BY THE HALE & KILBURN MFG. CO., Philadelphia, Pa., U. S. A.

## SCARRITT FORNEY CAR SEATS CHAIRS



FIFTY PATTERNS.

RECLINING  
PARLOR  
SMOKING  
CAR  
SEATS AND CHAIRS

Manufactured in all woods  
to match car finish and in  
all colors, covered in Plush,  
Leather or Rattan.

Our Seats and Chairs in  
use by nearly 200 U. S.  
Railways and in 10  
Foreign Nations.

5 POINTS OF  
SUPERIORITY

Comfort, Simplicity,  
Durability,  
Elegance, Economy.



THEY ARE KNOWN THE WORLD OVER.

SCARRITT FURNITURE CO.

For information, address ST. LOUIS OFFICES:  
1520, 1522, 1524, 1526 N. 13th St., 412-414 N. 4th St., 612, 614, 616 N. 2d St. WAREHOUSES:  
314 Vine St., 805 N. 2d St.  
NEW YORK: 16 Warren St., where seats may be seen at the store of the Peerless Rubber Co. (Ground Floor.)

ST. LOUIS, MO., U. S. A.

THE E. D. ALBRO CO.

IMPORTERS OF MAHOGANY

MANUFACTURERS OF HARDWOOD LUMBER AND

VENEERS DOMESTIC & FOREIGN  
OF EVERY DESCRIPTION.

FULL LINE OF SEASONED STOCK MILLS CINCINNATI OHIO.

EASTERN OFFICE:  
Cor. 6th & Lewis Streets,  
NEW YORK CITY.



WEST SHORE P. R. FREIGHT HOUSES, WEEHAWKEN, N. J.  
COVERED IN 1892 WITH

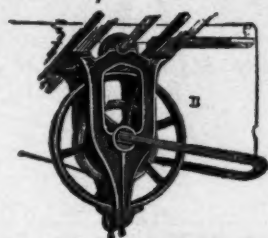
## WARREN'S "ANCHOR BRAND" NATURAL ASPHALT ROOFING.

This Roofing is also in use by Boston & Albany R. R.; Pennsylvania R. R.; New York, New Haven & Hartford R. R.; New York Central & Hudson River R. R. We shall be pleased to furnish samples of our **ANCHOR BRAND ASPHALT CEMENT AND FELT** that have been in use for 15 years and are still in good condition.

Send for Circulars, Samples and Estimates on Work to

**WARREN CHEMICAL & MFG. CO., 79 Fulton St., New York, U. S. A.**

## New Pat. Whip Hoist.



A Single Lever  
Hoists,  
Lowers and  
Holds the Load.

New Patent Balanced Segment  
FRICTION PULLEY.



**VOLNEY W. MASON & CO., Providence, R. I.**

## THE ACME MACHINERY CO., CLEVELAND, OHIO



MANUFACTURERS OF  
**BOLT HEADERS**  
AND SINGLE AND DOUBLE  
**Automatic Bolt Cutters**



Cutting threads from 1/4 in. to 6 in. diameter. Also separate Heads and Dies, which can be put on almost any of the different Bolt Cutters in the market, and parties still using the old style of either Plain or Case Die Heads will find it to their advantage to adopt the Acme.

By our new system of Cap Dies, the Die or Chaser costs but a trifle new, and can be recut a number of times, thus making the Acme Die the cheapest in the market.

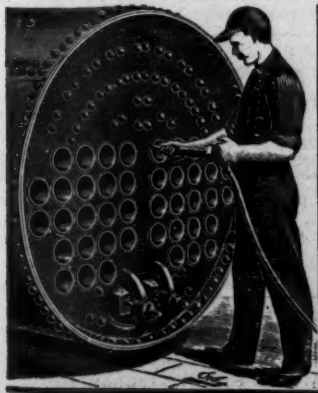
The Head has a positive lock, which cannot yield or spring, thus insuring true and perfect work.

## THE BROWN HOISTING AND CONVEYING MACHINE CO. CLEVELAND, O.

MACHINERY FOR HANDLING  
COAL AND ORE.

# CRANES

NEW YORK.  
HAVEMEYER BLDG.  
PITTSBURG.  
CARNEGIE BLDG.  
CHICAGO.  
MARQUETTE BLDG.



## CHICAGO PNEUMATIC TOOL CO.

1553 Monadnock Block, CHICAGO,

MANUFACTURERS OF

## Pneumatic Tools,

Especially adapted for Railway Shops in calking boilers, beading flues, cutting out firebox patches, cutting off rivets and stay bolts, heading rivets, chipping iron and steel castings, and cutting key slots, driving nails and spikes on car work. Will bead two locomotive flues per minute. All tools sent on ten days' trial, subject to approval, and guaranteed for one year against repairs.

## Index to Advertisers.

### Adjustable Squares:

E. L. Deane, Holyoke, Mass.

### Air Brakes:

Westinghouse Air Brake Co., Pittsburgh, Pa.

### Air Brake Hose:

Peerless Rubber Co., N. Y. City.

### Air Brake Fittings:

Crane & Co., Chicago, Ill.

### Air Compressors:

Edward P. Allis Co., Milwaukee, Wis.

Clayton Air Compressor Works, 26 Cortlandt

St., New York.

Igersoll-Sargent Drill Co., New York City.

Pedrick & Ayer, Philadelphia, Pa.

The Norwalk Iron Wks. Co., South Norwalk,

Conn.

Rand Drill Co., New York.

### Asbestos:

Sall Mountain Asbestos Co., Chicago, Ill.

### Asbestos Materials:

H. F. Watson Co., Erie, Pa.

### Axles:

Krupp, (Frosser & Son, 15 Gold St., New York)

### Balance Slide Valves:

Hammett, M. C., Troy, N. Y.

### Balanced Steam Traps:

D. Eate & Seeley Co., Boston, Mass.

### Bel Cord and Couplings:

Wellington, Henry W., Boston, Mass.

### Boilers and Engines:

Babcock & Wilcox Co., New York, N. Y.

### Boiler Covering:

The Kelley Co., Mineral Point, Wis.

Keasbey & Mattison Co., Ambler, Pa.

### Boiler Plate:

Ewald Iron Co., St. Louis, Mo.

Shoenberger Steel Co., Pittsburgh, Pa.

### Boiler Tubes:

Allison Mfg. Co., Philadelphia, Pa.

Krupp, (Frosser & Son, 15 Gold St., New York).

### Bolt Cutters:

Acme Machinery Co., Cleveland, O.

Howard Iron Works, Buffalo, N. Y.

### Bolts and Nuts:

Port Chester Bolt and Nut Co., Port Chester, N. Y.

### Bolsters:

Fox Solid Pressed Steel Co., Chicago, Ill.

### Boring Tools:

Armstrong Bros. Tool Co., Chicago, Ill.

### Brakebeams:

Nat. Hollow Brake Beam Co., Chicago, Ill.

### Cars:

The Allison Mfg. Co., Philadelphia, Pa.

Billmeyer & Small Co., York, Pa.

Bradley Car Works, Worcester, Mass.

Carlisle Mfg. Co., Carlisle, Pa.

Harlan & Hollingsworth Co., Wilmington, Del.

Jackson & Sharp Co., Wilmington, Del.

Jackson & Woodin Mfg. Co., Berwick, Pa.

Lenoir Car Co., Lenoir City, Tenn.

North Carolina Car Co., Raleigh, N. C.

Russel Wheel and Foundry Co., Detroit, Mich.

Sheffield Car Co., Three Rivers, Mich.

### Car Couplings:

Chester Steel Castings Co., Philadelphia, Pa.

Gould Coupler Co., New York City, N. Y.

McConway & Torley Co., Pittsburgh, Pa.

Standard Coupler Co., New York City, N. Y.

Tower Coupler Nat. Mfg. Co., Castings Co., Chicago.

### Car Heaters:

Baker, W. C., New York.

Safety Car Heat. & L't Co., New York.

### Car Lighting:

Safety Car Heating and Lighting Co., New York.

### Car Roofings:

H. F. Watson Co., Erie, Pa.

### Car Roofs:

C. B. Hutchins & Sons, Detroit, Mich.

The Standard Paint Co. (F. & B. Ruberoid), New

York, N. Y.

### Car Seats:

Bushnell Mfg. Co., Easton, Pa.

Hale & Kilburn Mfg. Co., Philadelphia, Pa.

Hartford Wire Mattress Co., Hartford, Conn.

Scarritt Furniture Co., St. Louis, Mo.

### Car Springs:

Scott, Chas., Spring Co., Philadelphia, Pa.

### Car Wheels:

Allen Paper Car Wheel Co., Chicago, Ill.

Bass Foundry & Mach. Wks., Fort Wayne, Ind.

Boies Steel Wheel Co., Scranton, Pa.

Chester Steel Castings Co., Philadelphia, Pa.

J. H. Bass, Chicago, Ill.

Krupp (Frosser & Son, 15 Gold St., New York).

Lenoir Foundry Co., Lenoir City, Tenn.

Lodell Car Wheel Co., Wilmington, Del.

Mowry Car Wheel Works, Cincinnati, O.

Ramapo Wheel and Foundry Co., Ramapo, N. Y.

St. Louis Car Wheel Co., St. Louis, Mo.

### Car Wheel Tires:

Krupp (Frosser & Son, 15 Gold St., New York).

### Car Ventilator:

M. C. Hammett, Troy, N. Y.

### Clocks:

The Prentiss Clock Imp. Co., N. Y. City.

### Corrugated Furnaces:

Continental Iron Works, Brooklyn, N. Y.

### Crank Pins:

Krupp (Frosser & Son), 15 Gold St., New York.

Continued on page 16.

## INDEX TO ADVERTISERS.—Continued.

- Crosscutting Lumber:**  
Lehigh Valley Crosscutting Wks, Perth Amboy, N. J.
- Drawing Instruments:**  
Theodore Alleneder & Sons, Philadelphia, Pa.  
F. Weber & Co., Philadelphia, Pa.
- Drill Presses:**  
Gould & Eberhardt, Newark, N. J.
- Electric Supplies:**  
Miamus Electric Co., Miamus, Conn.
- Elevating and Conveying Materials:**  
Link Belt Engineering Co., Philadelphia, Pa.
- Emery Wheels:**  
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.  
Dickerman Emery Wheel & Mach. Co., Bridgeport, Conn.  
Sterling Emery Wheel Co., Tiffin, O.
- Engineers:**  
Scoysmith & Co., New York City.
- Engineers' Materials:**  
Chas. F. Ketcham & Co. New York.  
Keuffel & Esser Co., New York, N. Y.
- Engines and Machinery:**  
Ed. P. Allis & Co., Milwaukee, Wis.
- Engraving:**  
Chas. F. Ketcham, New York.  
Photo Engraving Co., New York.  
R. D. Servoss, New York.
- Export Merchants:**  
Flint, Eddy & Co., New York City, N. Y.
- Fences:**  
Page Woven Wire Fence Co., Adrian Mich.
- Financial Broker:**  
F. H. Pettingell, Colo. Springs, Colo.
- Firebox Steel:**  
Ewald Iron Co., St. Louis, Mo.  
Schoenberger Steel Co., Pittsburgh, Pa.
- Flexible Joint:**  
Moran Steam Flex. Joint Co., Louisville, Ky.
- Forgings and Castings:**  
Krupp (Prosser & Son, 15 Gold St., New York).
- Frogs & Crossings:**  
Ramapo Wheel & Fdry. Co. Ramapo, N. Y.  
Weir Frog Co., Cincinnati, O.
- Fuel Oil Burner:**  
Thurman Fuel Oil Burner Co., Indianapolis, Ind.
- Gear Cutters:**  
Gould & Eberhardt, Newark, N. J.
- Grain Doors:**  
Chicago Grain Door Co., Chicago, Ill.
- Hand Cars:**  
Sheffield Car Co., Th ee Rivers, Mich.
- Holts and Traction Pulleys:**  
Volney W. Mason & Co., Providence, R. I.
- Holting Machinery:**  
Brown Holisting & Conveying Machine Co., Cleveland, O.  
J. S. Mundy, Newark, N. J.  
H. J. McKeown, Cincinnati, O.  
The Contractors' Plant Mfg. Co., Buffalo, N. Y.  
W. A. Crook & Bros. Co., Newark, N. J.
- Hollow Stay Bolt Iron:**  
Falls Hollow Staybolt Co., Cuyahoga Falls, O.
- Hydraulic Jacks:**  
Dudgeon, R., New York, N. Y.  
Watson & Stillman, New York, N. Y.
- Ice and Refrigerating Machinery:**  
Newburgh Ice Machine & Engine Co., Newburgh, N. Y.
- Injectors:**  
Nathan Mfg. Co., New York, N. Y.  
Sellers & Co., Wm., Philadelphia, Pa.
- Insulating Papers:**  
H. F. Watson & Co., Erie, Pa.
- Insulating Papers, P. & B. Waterproof:**  
Standard Paint Co., New York.
- Jacks:**  
Dudgeon, R., New York, N. Y.  
Norton, A. O., Boston, Mass.  
Watson & Stillman, New York, N. Y.
- Journal Bearings:**  
Ajax Metal Co., Philadelphia, Pa.  
Magnolia Anti-Friction Metal Co., N. Y.  
Phosphor-Bronze Smelting Co. (L'd), Phil'a, Pa.
- Lathes:**  
Gould & Eberhardt, Newark, N. J.
- Locomotives:**  
Baldwin Loco. Works Philadelphia, Pa.  
Brooks Loco. Wks., Dunkirk, N. Y.  
Manchester Loco. W'ks, Manchester, N. H.  
Pittsburgh Loco. & Car W'ks., Pittsburgh, Pa.  
Rogers Locomotive Co., Paterson, N. J.  
Richmond Loco. & Mach. Works, Richmond, Va.  
Schenectady Locomotive Works, N. Y.

Continued on page 17.



A special Car Roller is made, furnished with Brackets suitable for all classes of fittings. Used a over the world wherever cars are run.

**STEWART HARTSHORN CO.,**

Office and Factory, **EAST NEWARK, N. J.**  
**NEW YORK, 486 Broadway. CHICAGO, 203 and 205 Jackson St.**

## RAILWAY CAR CONSTRUCTION.

200 PAGES. 500 ENGRAVINGS.

By WILLIAM VOSS.

With Full Working Drawings of Every Style of Car Now  
Used on American Railroads.

—ADDRESS—

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL,

Morse Building, New York.

## STEAM ENGINEERING

Explained by E. SPANGENBERG, C. E.  
More than 2,000 questions with argued answers and over 500 illustrations, as well as his Arithmetic, Algebra, plane and solid Geometry, are sold by every Reliable Book-Dealer for 75 cents per volume, or will be sent postpaid after receipt of price by the undersigned. Prospectus of 32 pages sent free on application. **Laborers' Instruction Pub. Co., St. Louis, Mo.**



## IT'S TIME YOU KNEW

The Merits of a Vertical Miller.

## THE BECKER No. 5

Embodies the latest improvements in this type of machine. It is more practical, has greater adaptability and is more o a labor saver than any other Miller on the market. It will pay you to get acquainted with it.

THE JOHN BECKER MFG. CO.,

Mention this paper. 376 Water St., FITCHBURG, MASS., U. S. A



## W. DEWEES WOOD COMPANY.

## Patent Planished Sheet Iron

Patented Jan. 10, 1883; Feb. 12, 1884; Sept. 9, 1873; Jan. 1, 1876; April 15, 1884; June 10, 1884; Aug. 31, 1886; Dec. 10, 1878; Jan. 1, 1884; March 4, 1884; Jan. 6, 1885; Aug. 31, 1886; Jan. 1, 1889; Jan. 17, 1893.

Guaranteed fully equal, in all respects, to the Imported Russia Iron.

LOCOMOTIVE JACKET IRON OUR SPECIALTY.

General Offices and Works, **McKEESPORT, PA.**  
BRANCH OFFICE, 111 WATER ST., PITTSBURGH, PA.



TRADE-MARK

**CHICAGO GRAIN DOOR CO.****RABBETED GRAIN DOORS.**

"The only obstructions permitted inside a modern box car are  
**GRAIN DOOR RODS."**

Why not remove this objection by using.

**THE CHICAGO RABBETED GRAIN DOOR.****THE ARMSTRONG MANUFACTURING CO.**

BRIDGEPORT, CONN.

Manufacture High Grade Tools Celebrated for their  
Time and Labor Saving Qualities.

Pipe Threading and Cutting-off Machines  
Stocks and Dies and Other Tools for

**WATER, • STEAM AND • GAS • FITTERS.**

Bolt Dies, Lathe Dogs, Pipe  
Vises, etc., etc.

A Postal will bring our Catalogue.

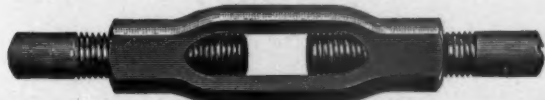


No. 1 MACHINE.

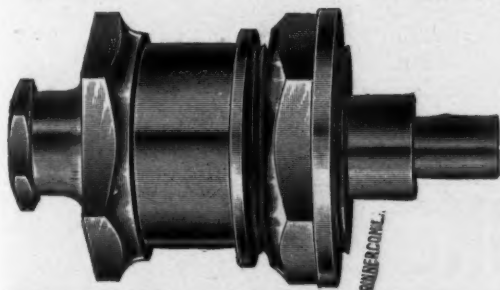
NEW YORK OFFICE: 139 CENTRE ST.

**THE CENTRAL IRON & STEEL CO.,**

**BRAZIL, INDIANA,**  
MANUFACTURERS OF

**Wrought Iron Open Hexagonal Turnbuckles**MADE FROM THE **BEST CHARCOAL IRON.**

Guaranteed Stronger than any Similar Article on the Market.

**BANGS' PATENT AUTOMATIC, ROD and ECCENTRIC CUPS.**

By the use of these Cups perfect lubrication is attained, with less than one-half the quantity of oil used by any other. They will not break off, being made of Aluminum, of one-third the weight and greater tensile strength than brass.

—MANUFACTURED BY—

**E. D. BANGS Oil Cup Co., Ltd.**

718 to 728 Hanover St.,  
P. O. Box 257. MILWAUKEE, WIS.  
Send for Circulars.

**BOSTON AND MAINE R. R.**

The Great Tourist Route to All SUMMER RESORTS of

**EASTERN AND NORTHERN NEW ENGLAND, CANADA AND THE PROVINCES:**

Winnepisaukee, Sunapee, Champlain, Memphremagog, St. John,  
Rangeley and Moosehead Lakes;

Adirondack, White Mountains and Green Mountains Regions;

Mt. Desert, St. Andrews, and all Beach and Coast Resorts of New England,  
Montreal, Quebec, St. John, Halifax.

Lowest rates between the principal New England points and the West and Northwest. Daily trains between Boston and the West, and the only line running through sleepers between Boston and St. Paul and Minneapolis.

Summer Publications Descriptive of Summer Resorts, "All Along Shore," "Among the Mountains," "Lakes and Streams," all profusely illustrated, will be sent postpaid on receipt of 10c. in stamps each. Excursion book giving Rates, Hotel and Boarding House List, etc., will be sent free on application. Address General Passenger Department, B. & M. R. R., Boston.

W. F. BERRY, Gen'l Traffic Mgr.

D. J. FLANDERS, Gen'l Pass. and Ticket Agent.

**INDEX TO ADVERTISERS—Continued.**

**Locomotive Staybolt Iron:**  
Ewald Iron Co., St. Louis, Mo.  
Falls Hollow Staybolt Co., Cuyahoga Falls, O.

**Locomotive Tires:**  
Krupp (Prosser & Son, 15 Gold St., New York).

**Lubricants:**  
Dixon, Jos., Crucible Co., Jersey City, N. J.  
Leonard & Ellis, New York.

**Lubricators:**  
Connelly, J. T., Milton, Pa.  
Hammett, M. C., Troy, N. Y.

**Lumber:**  
Vanderbilt & Hopkins, New York.

**Machine Screws:**  
Worcester Machine Screw Co., Worcester, Mass.

**Machinery for Handling Coal:**  
C. W. Hunt Co., New York, N. Y.

**Machinists' Tools:**  
Armstrong Mfg. Co., Bridgeport, Conn.  
Acme Machinery Co., Cleveland, O.  
Becker Mfg. Co., The John, Fitchburg, Mass.  
Bement, Miles & Co., Phila., Pa.  
Bullard Machine Tool Co., Bridgeport, Conn.  
Chicago Pneumatic Tool Co., Chicago.  
Diamond Machine Co., Providence, R. I.  
J. Faessler, Moorily, Mo.  
Gould & Eberhardt, Newark, N. J.  
Jones & Lamson Machine Co., Springfield, Vt.  
Long & Allstatter Co., Hamilton, O.  
Pratt & Whitney Co., Hartford, Conn.  
Sellers, Wm. & Co., Philadelphia, Pa.  
Willis Shaw, Chicago, Ill.  
Watson & Stillman, New York, N. Y.

**Machinery:**  
R. Poole Son Co., Baltimore, Md.

**Mahogany, Fancy Woods & Veneers:**  
Albro Co., The E. D., Cincinnati, O.

**Mandrel Rolled Hollow Staybolt Iron:**  
Falls Hollow Staybolt Co., Cuyahoga Falls, O.

**Nut Locks:**  
Eureka Nut Lock Co., Pittsburgh, Pa.

**Oils:**  
Galena Oil Works (Limited), Franklin, Pa.  
Leonard & Ellis, New York.  
Signal Oil Works, Franklin, Pa.

**Oil Cups:**  
E. D. Bangs' Oil Cup Co., Milwaukee, Wis.

**P. & B. Waterproof Insulating Paper:**  
The Standard Paint Co., New York.

**Packing:**  
Silver Lake Co., Boston, Mass.  
U. S. Metallic Packing Co., Philadelphia, Pa.  
Watson & Stillman, New York.

**Paints:**  
Detroit Graphite Mfg. Co., Detroit, Mich.  
F. W. Devoe & Co., New York  
Felton, Sibley & Co., Philadelphia, Pa.  
The Standard Paint Co., P. & B., New York, N. Y.  
Universal Protective Paint Co., Chicago.

**Patents:**  
Howson & Howson, Philadelphia, Pa.  
Washington Patent Agency, Washington, D. C.

**Perforated Sheet Metals:**  
Robt. Aitchison Perforated Metal Co., Chicago, Ill.  
Harrington & King Perforating Co., The, Chicago, Ill.

**Pipe and Boiler Coverings:**  
American Heat Insulat'g Co., Pittsburgh, Pa.

**Pipe Coverings:**  
H. F. Watson, Erie, Pa.

**Piston Rods:**  
Krupp (Prosser & Son, 15 Gold St., New York).

**Pneumatic Tools:**  
Chicago Pneumatic Tool Co., Chicago, Ill.

**Portable Drills:**  
Stow Mfg. Co., Binghamton, N. Y.

**Polished Shafting:**  
The Finished Steel Co., Youngstown, O.

**Power Punches, Shears and Hammers:**  
Long & Allstatter Co., Hamilton, O.

**Power Presses:**  
Cady Mfg. Co., Cleveland, O.

**Presses and Dies:**  
Ferracute Machine Co., Bridgeton, N. J.

**Pressed Steel:**  
Fox Solid Pressed Steel Co., Chicago, Ill.  
Shoen Mfg. Co., Philadelphia and Pittsburg, Pa.

**Pumps:**  
Cameron, A. S., Steam Pump Wks., New York.  
Merrill Mfg. Co., New York.

**Punches and Shears:**  
The Cady Mfg. Co., Cleveland, O.  
Long & Allstatter Co., Hamilton, O.  
I. P. Richards, Providence, R. I.

**Railways:**  
Big Four Route.  
Boston & Albany.  
Boston & Maine R. R.  
Fitchburg R. R.  
Lake Shore & Michigan Southern.  
New York & New England Ry.

Continued on page 13.

## INDEX TO ADVERTISERS—Continued.

- New York, N. H. & Hartford R. R.  
 Pennsylvania R. R.  
 Queen & Crescent Route.
- Railway Speed Recorder:**  
 Boyer Co., St. Louis, Mo.
- Railway Supplies:**  
 Chester Steel Castings Co., Philadelphia, Pa.  
 Ewald Iron Co., St. Louis, Mo.  
 Q. & C. Co., Chicago.
- Roofing:**  
 Warren Chemical Mfg. Co., New York
- Rubber:**  
 Peerless Rubber Mfg. Co., New York City.
- Safety Valves:**  
 Ashton Valve Co., Boston, Mass.
- School, Technical:**  
 The International Correspondence Schools  
 Scranton, Pa.  
 Correspondence School of Technology, Cleveland,  
 Rensselaer, Polytechnic Inst., Troy, N. Y.
- Screws:**  
 Worcester Machine Screw Co., Worcester, Mass.
- Screws and Taps:**  
 Cleveland Twist Drill Co., Cleveland, O.  
 Harvey Hubbell, Bridgeport, Conn.
- Shade Rollers:**  
 Stewart Hartshorn Co., Newark, N. J.
- Shapers:**  
 Gould & Eberhardt, Newark, N. J.
- Sheet-Iron:**  
 Wood Co., W. Dewees, McKeesport, Pa.
- Ship Builders:**  
 Cleveland Ship Building Co., Cleveland, O.
- Staybolt Iron:**  
 Ewald Iron Co., St. Louis, Mo.  
 Falls Hollow Staybolt Co., Cuyahoga Falls, O.
- Steam Engineering:**  
 Laborers Inst. Pub. Co., St. Louis, Mo.
- Steam Gages:**  
 Crosby Steam Gage Valve Co., Boston, Mass.  
 Reliance Gauge Co., Cleveland, O.
- Steam Gage Valves:**  
 Ashton Valve Co., Boston, Mass.
- Steam Pumps:**  
 A. S. Cameron Steam Pump Wks., New York  
 City.  
 Willis Shaw, Chicago, Ill.
- Steam Shovels:**  
 The Vulcan Iron Works, Toledo, O.
- Steam Traps:**  
 D'Este & Seeley Co., Boston, Mass.
- Steel:**  
 Aetna Standard Iron & Steel Co., Bridgeport, O.  
 Carron Steel Co., Pittsburgh, Pa.  
 Jones, B. M., & Co., Boston, Mass.  
 Krupp (Prosser & Son, 15 Gold St., New York).  
 Latrobe Steel Co., Latrobe, Pa.  
 Penn. Steel Co., Steelton, Pa.  
 Schoenberger Steel Co., Pittsburgh, Pa.
- Steel Castings:**  
 Chester Steel Castings Co., Phila., Pa.  
 J. A. & P. E. Dutcher Co., Milwaukee, Wis.  
 Krupp Prosser & Son, 15 Gold St., New York.  
 Solid Steel Co., The, Alliance, O.
- Steel Rails:**  
 Pennsylvania Steel Co., Steelton, Pa.
- Steel Tires:**  
 Krupp (Prosser & Son, 15 Gold St., New York).  
 Latrobe Steel Works, Latrobe, Pa.
- Steel Trucks:**  
 American Steel Foundry Co., St. Louis.
- Tank Steel:**  
 Aetna Standard Iron & Steel Co., Bridgeport, O.  
 Ewald Iron Co., St. Louis, Mo.
- Taps and Dies:**  
 Cleveland Twist Drill Co., Cleveland, O.  
 Connelly, J. T., Milton, Pa.
- Testing Machines:**  
 Riehle Bros. Testing Machine Co., Philadelphia,  
 Pa.
- Tires (Steel):**  
 Krupp (Prosser & Son, 15 Gold St., New York).
- Tools:**  
 Armstrong Mfg. Co., Bridgeport, Conn.  
 Gould & Eberhardt, Newark, N. J.
- Tool Holders:**  
 Gould & Eberhardt, Newark, N. J.
- Track Sanders:**  
 H. L. Leach, Boston, Mass.
- Tube Expanders:**  
 Dudgeon, R., New York, N. Y.
- Turnbuckles:**  
 Central Iron and Steel Co., Brazil, Ind.  
 Cleveland City Forge and Iron Co., Cleveland, O.  
 Merrill Bros., Brooklyn, N. Y.
- Twist Drills:**  
 Cleveland Twist Drill Co., Cleveland, O.  
 Morse Twist Drill Co., New Bedford, Mass.
- Valves:**  
 Ross Valve Co., Troy, N. Y.
- Varnishes:**  
 Devoe, F. W., & Co., New York.  
 Harland, Wm., & Sons, New York.  
 Pratt & Lambert, New York.  
 Valentine & Co., New York.

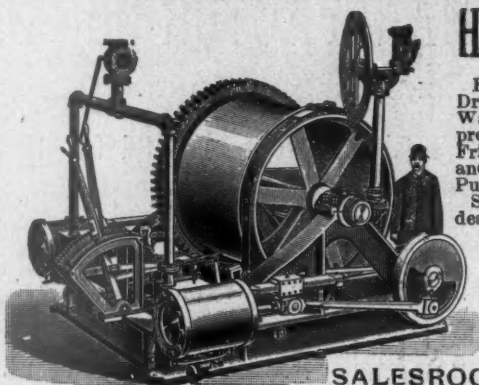
Continued on page 19.

**ASBESTOS ROPE AND WICK PACKINGS.**

Felts, Mill Boards and Fibres, Sectional Pipe and Boiler Coverings.

**ASBESTOS \* ROOFINGS.**

All Kinds of BUILDING AND ROOFING PAPERS.

**H. F. WATSON COMPANY, Erie, Pa.**  
CHICAGO. NEW YORK. NASHVILLE, TENN.**HOISTING MACHINERY**

For Mining, Quarrying, Coal Handling, Pile Driving, Bridge Building, Log Hauling, Cable Ways, and for General Contractors' Use. Improve Electric Hoists, Single and Double, Patent Friction Drum, Compound, Geared with Brakes, and Reversible, for General Hoisting and Mining Purposes. Send for Illustrated Catalogue giving full description, etc.

Correspondence Solicited.

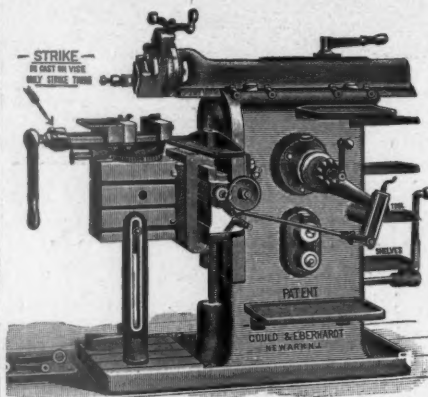
**W. A. CROOK & BROS. CO.,**  
117-123 POINIER STREET,  
NEWARK, N. J.

SALESROOMS: 143 Liberty Street, N. Y.

**STERLING**  
Emery Wheel Mfg. Co.

TIFFIN, OHIO.

—ALSO MANUFACTURERS OF—

Advance Safety Emery and Corundum  
Wheels, with or without Wire Web**GOULD & EBERHARDT, NEWARK, N. J.****"DOUBLE TRIPLE  
QUICK STROKE"  
SHAPER.**

12 in., 16 in., 20 in., 24 in., 26 in., 30 in.

Capable of giving from 50 to 100 per cent. more  
strokes per minute over any other  
make on the market.DOUBLE TRIPLE QUICK STROKE  
(TRADE MARK)

SEND FOR CIRCULAR.

**We produce HALF-TONE  
AND  
LINE ENGRAVINGS**

... FOR THE ...

**AMERICAN ENGINEER** and other first-class  
journals.

Estimates given for completing catalogues and fine printed work.

**PHOTO-ENGRAVING CO., 67 Park Place, New York.****MORSE TWIST DRILL AND MACHINE COMPANY**

MANUFACTURES  
 Patent Twist Drills, Machine Bits for Wood, Bit Stock Drills, Reamers, Standard Gauges, Milling Cut-  
 ters, and Special Tools for use in Railroad, Car and Locomotive Shops. **NEW BEDFORD, Mass.**

# DIRECTORY

of the Railroads of the United States and Canada, showing the gage, length of road, number of locomotives and number of cars; and giving the names and titles of their principal officers in charge of the operating, purchasing and rolling stock departments.

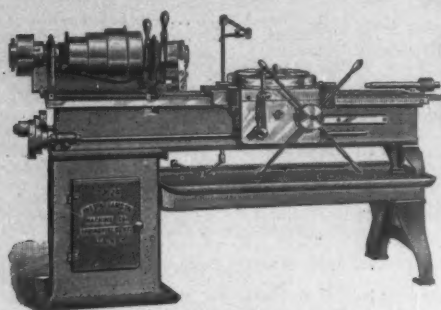
**Addison & Penn'a Ry.** 4-8½ g. 46 m. 4 lo. 26 c.  
F. M. Baker, *Gen. Supt. & P. Agt.*, Addison, N. Y.  
T. Langtine, *M. M.*, Addison, N. Y.  
**Adirondack & St. Lawrence.** (See N. Y. Central.)  
**Arizona & New Mexico Ry.** 3 g. 71 m. 3 lo. 60 c.  
James Colquhoun, *Pres.*, Clifton, Ariz.  
J. G. Hopkins, *Sec. & Treas.*, Clifton, Ariz.  
**Alabama Midland Ry.** (See Plant System.)  
**Alberta Ry. & Coal Co. and Great Falls & Canada Ry. Co.** 3 g. 201 m. 18 lo. 412 cars.  
E. T. Galt, *Pres.*, Lethbridge, Alberta.  
W. D. Barclay, *Man. & Pur. Agt.*, Lethbridge, Alberta.  
T. McNabb, *M. M.*, Lethbridge, Alberta.  
**Albemarle & Pantego R.R.** (See Norfolk & Southern.)  
**Albemarle & Raleigh R.R.** (See Atlantic Coast Line.)  
**Allegheny & Kinzua R.R.** 4-8½ g. 33 m. 5 lo. 68 c.  
A. D. Scott, *Receiver*, Buffalo, N. Y.  
S. S. Bullis, *Gen. Man.*, Olean, N. Y.  
M. D. Murray, *G. S., Pur. Agt.*, M. M. & C. B., Bradford, Pa.  
**Allegheny Valley Ry. Co.** 4-9 g. 259 m. 85 lo. 3,042 c.  
W. H. Barnes, *Pres.*, Philadelphia, Pa.  
D. McCargo, *Gen. Supt.*, Pittsburgh, Pa.  
H. D. Mason, *Pur. Agt.*, Pittsburgh, Pa.  
John C. Glass, *M. M.*, Verona, Pa.  
John Cowan, *M. C. B.*, Verona, Pa.  
**Alliance & Northern R.R.** 4-8½ g. 25 m. 21 lo. 38 cars.  
E. E. Scranton, *G. M. & P. A.*, Alliance, O.  
C. P. Finch, *M. C. B.*, Alliance, O.  
**Annapolis, Wash. & Balt. R. R.**  
4-8½ g. 20½ m. 3 lo. 9 c.  
John W. Brown, *Gen. Man. & Pur. Agt.*, Baltimore, Md.  
**Ann Arbor R. R.**  
John L. Beall, *M. M.*, Annapolis, Md.  
4 ft.-8½ g., 300 m. 44 l., 1,826 cars.  
H. W. Ashley, *Gen. Man.*, Toledo, O.  
F. S. Chandler, *Pur. Agt.*, Toledo, O.  
Robert Tawse, *M. M.*, Owosso, Mich.  
**Arkansas Midland R. R.** 4-8½ g. 74 m. 7 lo. 126 cars.  
J. J. Horner, *V.-P. & Gen. Man.*, Helena, Ark.  
J. B. Johnson, *Supt. & Pur. Agt.*, Helena, Ark.  
R. Allen, *M. M.*, Helena, Ark.  
John A. Greenough, *M. C. B.*, Helena, Ark.  
**Ashland Coal & Iron Ry. Co.** 4-8½ g. 22 m. 8 lo. 433 c.  
Douglas Putnam, *Gen. Man.*, Ashland, Ky.  
W. H. Apple, *M. M.*, Ashland, Ky.  
Robt. Peebles, *Pur. Agt.*, Ashland, Ky.  
Thos. Ryan, *M. C. B.*, Ashland, Ky.  
**Ashland & Pittsburgh Ry.** (See Penna. Co.)  
**Atchison, Topeka & Santa Fé R.R.**  
4-8½ g. 4,669.9 m. 839 lo. 542 pass. & 25,178 ft. c.  
Aldace F. Walker, *New York, N. Y.*, *Receivers*  
J. J. McCook, *New York, N. Y.*  
J. J. Frey, *G. M.*, Topeka, Kan.  
**Western Grand Div.**  
W. G. Nevin, *Gen. Pur. Agt.*, Chicago, Ill.  
John Player, *Supt. Machinery*, Topeka, Kan.  
J. Hodge, *M. C. B.*, Topeka, Kan.  
**Atlantic & Pacific Div.** Separate management.  
C. W. Smith, *Rec. & G. M.*, Chicago, Ill.  
T. R. Gabel, *Gen. Supt.*, Albuquerque, N. M.  
W. H. Smith, *Pur. Agt.*, Albuquerque, N. M.  
R. English, *Gen. M. M.*, Albuquerque, N. M.  
**Chicago Div.**  
C. F. Rossegule, *Supt.*, Chicago, Ill.  
James Collinson, *M. M.*, Fort Madison, Ia.  
**Colorado, Midland Div.**  
Eastern Div.: C. T. McLeilan, Topeka, Kan.  
Geo. W. Smith, *M. M.*, Topeka, Kan.  
John Purcell, *Asst. M. M.*, Argentine, Kan.  
Gulf, Colorado & Santa Fe Ry.  
4-8½ g. 1,058 m. 83 lo. 3,396 c.  
L. J. Polk, *Act. Gen. Man.*, Galveston, Tex.  
Geo. A. Hancock, *Supt. Mach.*, Galveston, Tex.  
J. W. Dickenson, *Div. Supt.*, Temple, Tex.  
J. W. Kelly, *Div. M. M.*, Temple, Tex.  
A. J. Davidson, *Div. Supt.*, Ft. Worth, Tex.  
L. H. Waugh, *Div. M. M.*, Cleburne, Tex.  
**Mid. Div.**: A. Turner, *Supt.*, Newton, Kan.  
Thos. Paxton, *Gen. M. M.*, Nickerson, Kan.  
**W. Div.**  
Chas. Dyer, *Supt.*, Pueblo, Colo.  
J. Forster, *M. M.*, La Junta, Col.  
**New Mex. Div.**  
Supt. Las Vegas, N. M.  
M. M., Raton, N. M.  
**Rio Gr. Div.**  
C. M. Taylor, *M. M.*, San Marcial, N. M.  
**Southern California Ry.**  
4-8½ g. 490 m. 25 lo. 216 c.  
K. H. Wade, *Gen. Man.*, Los Angeles, Cal.  
C. F. Lape, *Supt. M. & Car Dept.*, San Bernardino, Cal.  
**So. Kan. Div.**  
J. L. Barnes, *Supt.*, Chanute, Kan.  
Alva Mitchell, *M. M.*, Ottawa, Kan.  
**St. Louis & San Francisco Ry.**  
4-8½ g. 1,441 m. 195 lo. 5,929 c.  
B. F. Yoakum, *V.-P. & G. M.*, St. Louis, Mo.  
J. R. Groves, *Supt. Mach.*, Springfield, Mo.  
**Atlantic City R. R.** (See P. & B. R. R.)  
**Atlantic Coast Line:** Composed of the Richmond & Petersburg; Norfolk & Carolina; Petersburg, Wilmington & Weldon; Manchester & Augusta; Florence; Wilmington & Weldon and Wilmington, Columbia & Augusta; Central of So. Ca.; Cheraw & Darlington; North Eastern of S. C.  
4-9 g. 1,426 miles, 170 locomotives, 4,421 cars.  
J. R. Kenly, *Gen. Man.*, Wilmington, N. C.  
F. H. Fechtig, *Pur. Agt.*, Wilmington, N. C.  
John Bisset, *M. M.*, Wilmington, N. C.  
Jno. O'Brien, *M. M.*, Manchester, V.

J. H. Davis, *M. C. B.*, Wilmington, N. C.  
W. H. Day, *M. C. B.*, Florence, S. C.  
W. J. Acree, *M. C. B.*, Petersburg, Va.  
**Atlantic & Danville Ry.**  
3 and 4-9 g. 281.82 m. 27 lo. 749 cars.  
C. D. Owens, *Vice-Pres. & Gen. Man.*, Norfolk, Va.  
Adam Trederell, *Pur. Agt.*, Norfolk, Va.  
M. M. Reid, *M. M.*, Lawrenceville, Va.  
B. Pearce, *M. C. B.*, Lawrenceville, Va.  
**Atlantic & Lake Superior Ry. Co.**  
4-8½ g. 81 m. 5 lo. 65 cars.  
C. N. Armstrong, *Gen. Man.*, Montreal, Que.  
A. C. Wotele, *Pur. Agt.*, Montreal, Que.  
Jos. Hunter, *M. M. & M. C. B.*, Metapedia, Que.  
**Atlantic & No. Carolina R.R.** 4-9 g. 95 m. 7 l. 107 c.  
S. L. Dill, *Supt.*, Newbern, N. C.  
F. C. Roberts, *Pur. Agt.*, Newbern, N. C.  
W. R. Waters, *M. M.*, Newbern, N. C.  
J. B. Taylor, *M. C. B.*, Newbern, N. C.  
**Augusta Southern R.R.** 4-8½ g. 85m. 4 lo. 46 cars.  
James U. Jackson, *G. M. & P. A.*, Augusta, Ga.  
C. L. Paenghart, *M. M. & M. C. B.*, Augusta, Ga.  
**Au Sable & Northwestern.** 3 g. 110 m. 16 l. 325 c.  
G. A. Loud, *Gen. Man.*, Au Sable, Mich.  
W. F. Loud, *Pur. Agt.*, Au Sable, Mich.  
A. E. Walker, *M. M.*, McKinley, Mich.  
John Law, Jr., *M. C. B.*, McKinley, Mich.  
**Austin & North Western R.R.** 4-8½ g. 106 m. 8 l. 308c.  
Geo. A. Loud, *Gen. Man.*, Au Sable, Mich.  
Jno. Law, Jr., *Pur. Agt.*, Au Sable, Mich.  
A. E. Walker, *M. M.*, McKinley, Mich.  
J. Hartwick, *M. C. B.*, McKinley, Mich.

## B

**Baltimore, Chesapeake & Atlantic R.R.**  
4-8½ g. 88 m. 8 lo. 96 c.  
W. Thomson, *Gen. M. & P. A.*, Baltimore, Md.  
A. J. Benjamin, *Supt. & Pur. Agt.*, Salisbury, Md.  
Fred Strattnr, *M. M.*, Salisbury, Md.  
**Baltimore & Annapolis Short Line R. R.**  
4-8½ g. 26 m. 6 lo. 40 c.  
C. A. Coombs, *Gen. Man. & P. A.*, Baltimore, Md.  
J. P. Seward, *M. M.*, Annapolis, Md.  
T. Dodds, *M. C. B.*, Annapolis, Md.  
**Baltimore & Delaware Bay R. R. Co.**  
4-8½ g. 49 m. 3 lo. 7 cars.  
E. P. Stacey, *G. S. & Pur. A.*, Clayton, Del.  
**Baltimore & Potomac R.R.** (See Penna. R.R.)  
**Baltimore & Lehigh R. R. Co.**  
3 ft. g. 42.9 m. 10 lo. 221 cars.  
W. A. Moore, *G. M. & Pur. A.*, Baltimore, Md.  
G. W. Seidel, *M. M.*, Baltimore, Md.  
**Baltimore & Ohio R. R.**  
4-8½ g. 3,511.48 m. 858 lo. 28,588 cars.  
J. K. Cowen, *Pres. & Rec.*, Baltimore, Md.  
Oscar G. Murray, *Sec.*, Baltimore, Md.  
Wm. M. Greene, *Gen. Man.*, Baltimore, Md.  
Harvey Middleton, *G. Supt. M. P.*, Baltimore, Md.  
L. J. Buckley, *Pur. Agt.*, Baltimore, Md.  
I. N. Kalbaugh, *Supt. M. P.*, Lines East of Ohio River, Baltimore, Md.  
E. W. Grieves, *Supt. Car Dept.*, Baltimore, Md.  
**Main Stem Div.**  
Thos. Fitzgerald, *Gen. Supt.*, Baltimore, Md.  
S. B. Crawford, *M. M.*, Baltimore, Md.  
J. M. Marsteller, *M. M.*, Martinsburg, W. Va.  
P. Hayden, *M. M.*, Piedmont, W. Va.  
D. C. Courtney, *Div. M. M.*, Grafton, W. Va.  
**Pittsg. Div.**  
Thos. Fitzgerald, *Supt.*, Baltimore, Md.  
Thos. Trease, *Div. M. M.*, Pittsburgh, Pa.  
**Phil. Div.**  
Thos. Fitzgerald, *Supt.*, Baltimore, Md.  
E. T. White, *Div. M. M.*, Philadelphia, Pa.  
O. J. Kelley, *Gen. Fore.*, Philadelphia, Pa.  
**Trans-Ohio Div.**  
W. H. Harrison, *Supt. M. P.*, Newark, O.  
**Ohio Divs.**  
J. M. Graham, *Supt.*, Newark, O.  
Wm. Harrison, Jr., *Div. M. M.*, Newark, O.  
**Akron & Wooster Branch Div.**  
J. T. Johnson, *Supt.*, Akron, O.  
T. Taylor, *M. M.*, Chicago Junction, O.  
**Chicago Div.**  
P. C. Sneed, *Supt.*, Garrett, Ind.  
J. Billingham, *Div. M. M.*, Garrett, Ind.  
**Baltimore & Ohio Southwestern Ry. Co.**  
4-8½ g. 928 m. 220 lo. 7,516 c.  
L. G. Bawn, *Gen. Supt.*, Cincinnati, O.  
W. W. Peabody, *G. Man. & P. A.*, Cincinnati, O.  
J. G. Neuffer, *M. M. & M. C. B.*, Cincinnati, O.  
**Bangor & Aroostook R.R.** 4-8½ g. 306 m. 32 lo. 825 c.  
F. W. Cram, *V. P. G. M. & P. A.*, Bangor, Me.  
Orlando Stewart, *Supt. M. P. & E.*, Oldtown, Me.  
**Bangor & Portland Ry.** 4-8½ g. 50 m. 7 lo. 64 c.  
C. Miller, *G. Man. & P. A.*, Bangor, Pa.  
G. Holmes, *M. M.*, Bangor, Pa.  
Thos. Chamberlin, *M. C. B.*, Bangor, Pa.  
**Barre R. R. Co.** 4-8½ g. 26 m. 4 lo. 41 cars.  
F. W. Stanyan, *G. S. & Pur. A.*, Barre, Vt.  
G. Jacobson, *M. M.*, Barre, Vt.  
Chas. Robinson, *M. C. B.*, Montpelier, Vt.  
**Barclay R. R.** 4-8½ g. 16 m. 5 lo. 25 c.  
E. O. Macfarlane, *Supt.*, Towanda, Pa.  
**Bath & Hammondsport R. R.** 4-8½ g. 16 m. 2 lo. 9 c.  
H. S. Stebbins, *Man. & P. A.*, Hammondsport, N. Y.  
P. G. Zimmer, *M. M.*, Hammondsport, N. Y.  
C. G. Griswold, *M. C. B.*, Hammondsport, N. Y.  
**Bay of Quinte Ry. & Navigation Co.**  
4-8½ g. 85 m. 5 lo. 133 cars.  
R. C. Carter, *Gen. Man.*, Deseronto, Ont.  
F. S. Bathbus, *Pur. Agt.*, Deseronto, Ont.  
E. Trist, *M. C. B.*, Deseronto, Ont.  
**Beech Creek R. R.** 4-8½ g. 185 m. 47 l. 3,887 c.  
N. Y. C. & H. R. Lessee.  
J. D. Layng, *Gen. Man.*, New York City, N. Y.  
A. G. Palmer, *Supt. & P. A.*, Jersey Shore, Pa.  
Geo. Thompson, *M. M.*, Jersey Shore, Pa.  
A. L. Dravenstadt, *M. C. B.*, Jersey Shore, Pa.  
**Bellaire, Zanesville & Cin. Ry. Co.** 3 g. 111 m. 7 lo. 179c.  
J. K. Geddes, *Rec. & Gen. Man.*, Zanesville, O.

J. A. Cox, *Pur. Agt.*, Zanesville, O.  
V. B. Stubbins, *M. M.*, Zanesville, O.  
**Bellefonte Central.** 4-9 g. 23 m. 3 lo. 70 cars.  
F. H. Thomas, *Supt.*, Bellefonte, Pa.  
Robt. Frazer, *Pres. & P. A.*, Philadelphia, Pa.  
W. Bardett, *M. C. B.*, Bellefonte, Pa.  
**Bellingham Bay & British Columbia Ry.**  
4-8½ g. 24.40 m. 4 lo. 58 cars.  
C. L. Anderson, *Gen. Man. Supt. & Pur. A.*, New Whatcom, Wash.  
R. E. Nevins, *M. M. & M. C. B.*, New Whatcom, Wash.  
**Bennington & Rutland Ry.** 4-8½ g. 58 m. 12 lo. 327c.  
E. D. Bennett, *Supt. & Pur. Agt.*, Bennington, Vt.  
Chas. J. McMaisters, *Supt. M. P. & W.*, Rutland, Vt.  
**Birmingham & Atlantic Ry.** 4-8½ g. 35 m. 4 lo. 50 c.  
G. A. Mathison, *Gen. Supt. & Pur. A.*, Talladega, Ala.  
J. J. Thomas, Jr., *M. M. & M. C. B.*, Talladega, Ala.  
**Black Hills & Fort Pierre.** 3 g. 36.4 m. 5 lo. 125 c.  
T. J. Grier, *Gen. Man.*, Lead City, S. D.  
John A. Spargo, *M. M.*, Lead City, S. D.  
**Bloomsburg & Sullivan.** 4-9 g. 30 m. 4 lo. 28 cars.  
F. M. Leader, *Gen. Man. & Pur. Agt.*, Bloomsburg, Pa.  
**Boston & Albany R.R.**  
4-8½ g. 388 m. 240 lo. 7,242 c.  
W. H. Barnes, *Gen. Man.*, Boston, Mass.  
Thos. B. Purves, Jr., *Supt. R. S.*, Springfield, Mass.  
J. P. Condon, *For. C. Shop.*, Allston, Mass.  
C. H. Barnes, *Div. M. M.*, West Springfield, Mass.  
J. E. Doran, *For. Car. Sh.*, East Albany, N. Y.  
E. Priest, *Div. M. M.*, East Albany, N. Y.  
**Boston & Lowell R.R. (Leased to Boston & Maine)**  
**Boston & Maine R.R.** 4-8½ g. 1,717.22 m. 666 lo. 14,349c.  
Lucius Tuttle, *Pres.*, Boston, Mass.  
T. A. Mackinnon, *1st Vice-Pres.*, Boston, Mass.  
J. A. Farrington, *Pur. Agt.*, Boston, Mass.  
Henry Bartlett, *Supt. M. P.*, Boston, Mass.  
J. T. Chamberlain, *M. C. B.*, Boston, Mass.  
**West'n Div.**: Wm. Merritt, *Supt.*, Boston, Mass.  
A. B. Barrett, *Div. M. M.*, Boston, Mass.  
**Eastern Div.**  
W. T. Perkins, *Supt.*, Boston, Mass.  
P. M. Hammett, *Div. M. M.*, Boston, Mass.  
**Northern Div.**  
J. W. Sanborn, *Supt.*, Sanbornville, N. H.  
**Southern Div.**  
Wm. G. Bean, *Supt.*, Boston, Mass.  
E. T. Summer, *Div. M. M.*, East Cambridge, Mass.  
**Worc., Nashua & Port Div.**  
Frank Barr, *Supt.*, Nashua, N. H.  
**Connecticut & Passumpsic Div.**  
H. E. Folsom, *Supt.*, Lyndonville, Vt.  
L. C. Todd, *Div. M. M.*, Lyndonville, Vt.  
C. L. Aiken, *Div. M. M.*, Springfield, Mass.  
**Concord Div.**  
H. E. Chamberlin, *Supt.*, Concord, N. H.  
C. H. Wiggins, *Div. M. M.*, Concord, N. H.  
**White Mountain Div.**  
G. E. Cummings, *Supt.*, Woodsville, N. H.  
C. H. Wiggins, *M. M.*, Concord, N. H.  
**Boston & Providence R. R. (See Old Colony R.R.)**  
**Boston, Revere Beach & Lynn R.R.** 3 g. 14m. 11 lo. 88c.  
J. A. Feno, *Supt. & P. Agt.*, Boston, Mass.  
R. D. Sutherland, *M. M.*, Boston, Mass.  
John Coghlan, *M. C. B.*, Boston, Mass.  
**Bradford, Bordell & Kinzua R. R.** 3 g. 32m. 6 lo. 141c.  
J. C. McKenna, *Gen. M. & P. A.*, Bradford, Pa.  
Chas. Greenough, *M. M. & M. C. B.*, Bradford, Pa.  
**Brainerd & Northern Minnesota R. R.**  
4-8½ g. 70 m. 72 lo. 750 cars.  
O. O. Winter, *Gen. Man.*, Brainerd, Minn.  
Walter H. Brinson, *Supt.*, Brainerd, Minn.  
W. F. Brooks, *Pur. Agt.*, Minneapolis, Minn.  
J. N. Sanborn, *M. M. & M. C. B.*, Brainerd, Minn.  
**Brooklyn & Brighton Beach R. R.**  
4-8½ g. 15 m. 8 lo. 44c. 8 ft. c.  
Wm. Finley, *Supt. & Pur. Agt.*, Brooklyn, N. Y.  
John Finley, *M. M.*, Brooklyn, N. Y.  
H. Watts, *For. Car Rep.*, Brooklyn, N. Y.  
**Brooklyn Elevated R.R.** 4-8½ g. 20 m. 95 lo. 260 c.  
J. D. Barton, *Gen. Supt.*, Brooklyn, N. Y.  
Elisha Dyer, Jr., *Pur. Agt.*, Brooklyn, N. Y.  
E. P. Mallinson, *M. M. & M. C. B.*, Brooklyn, N. Y.  
**Brunswick & Western R. R. (See Plant System.)**  
**Buffalo, Attica & Arcade R. R. Co.**  
4-8½ g. 26 m. 1 lo. 1c.  
S. S. Bullis, *Gen. Man.*, Olean, N. Y.  
Sam'l T. Dyke, *M. M. & M. C. B.*, Attica, N. Y.  
**Buffalo, Rochester & Pittsburgh Ry.**  
4-8½ g. 336 m. 137 lo. 6,850 c.  
G. E. Merchant, *Asst. to Pres. & Pur. Agt.*, Rochester, N. Y.  
C. E. Turner, *Supt. M. P.*, Rochester, N. Y.  
F. J. Lauer, *M. C. B.*, Rochester, N. Y.  
**Rochester & Buffalo Div.**  
J. A. Barbydt, *M. M.*, Rochester, N. Y.  
**Pittsburg Div.**  
A. Rardsley, *M. M.*, Bradford, Pa.  
**Buffalo & Squehanna Ry.**  
4-8½ g. 112 m. 16 lo. 348 cars.  
C. W. Goodyear, *Gen. Man.*, Buffalo, N. Y.  
E. O. Cheney, *Pur. Agt.*, Buffalo, N. Y.  
W. A. Brown, *Act. M. M.*, Austin, Pa.  
**Burlington & Mo. Riv. R.R. (in Bur. & West'n Ry.)**  
**Burlington & North-West'n & N. B. & West'n Ry.**  
4-8½ g. 123 m. 7 lo. 397 c.  
Robt. Law, *Man.*, Burlington, Ia.  
Adam Metz, *M. M.*, Burlington, Ia.  
**Burlington, Cedar Rapids & Northern Ry.**  
4-8½ g. 1,136.47 m. 128 lo. 4,500 cars.  
C. J. Ives, *Pres. & Gen. Man.*, Cedar Rapids, Ia.  
Robt. Williams, *Gen. Supt.*, Cedar Rapids, Ia.  
W. J. Morrison, *Pur. Agt.*, Cedar Rapids, Ia.  
R. W. Bushnell, *M. M.*, Cedar Rapids, Ia.  
G. L. Dickover, *G. F. Car Sh.*, Cedar Rapids, Ia.



2 x 24 FLAT TURRET LATHE.

**JONES & LAMSON MACHINE CO.,**  
SPRINGFIELD, VT., U. S. A.,

Sole Builder of the  
**FLAT TURRET LATHE.**

Foreign Representatives: M. Koyemann, Charlottenstrasse 112, Dusseldorf, Germany; Adolphe Janssens, 16, Place De La Republique, Paris, France; Charles Churchill & Co., 6-15 Leonard St., Finsbury, London, E. C., and 6, Albert St., Birmingham, England; and Henry Kelley & Co., 26, Pall Mall, Manchester, England.

## Moberly Machine Works

... MANUFACTURE ...

Rolling Machines,  
Lathe Chucks,  
Equalizer Jacks,  
Ball Reamers,  
Large Ratchets,  
Ventilators,  
Special Tools.

## THE BOSS ROLLER FLUE EXPANDER



IMPROVED SECTIONAL



Guaranteed to do more work with less repairs  
than any other. Write for Catalogue.

**J. FAESSLER, Moberly, Mo.**

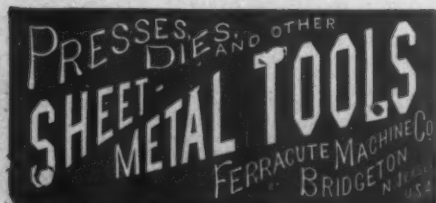


THIS is a miniature of our No. 5 grinder head machine. Our heads are all of this style.

They are made with cast-iron engine lathe boxes. The most exact method of construction is used. The best is none too good for us; we do not believe it is for you.

**DIAMOND MACHINE CO.**

PROVIDENCE, R. I., and CHICAGO, ILL.



## SUPERIOR GRAPHITE PAINT

For Bridges, Roofs, Structural Iron

and all Exposed Metal or Wood Surfaces. Warranted not affected by heat, cold, salt brine, acid fumes, smoke or chemicals.

DETROIT GRAPHITE MFG. CO., DETROIT MICH.

## STEEL CASTINGS

FROM 1 TO 40,000 POUNDS WEIGHT  
Of Open Hearth, Chester or Bessemer Steel.

True to Pattern. Sound. Solid.

Gearing of all Kinds, Crank Shafts, Knuckles  
for Car Couplers.

Cross-Heads, Rockers, Piston-Heads, etc., for Locomotives.  
Steel Castings of Every Description.

**CHESTER STEEL CASTINGS CO.,**  
Works, Chester, Pa. Office, 407 Library St., Phila., Pa.



## L. COES'

Genuine Improved Knife-Handle Patent

## SCREW WRENCHES

MANUFACTURED BY

**COES WRENCH CO., Worcester, Mass.**

ESTABLISHED 1839. Registered April 9, 1895.

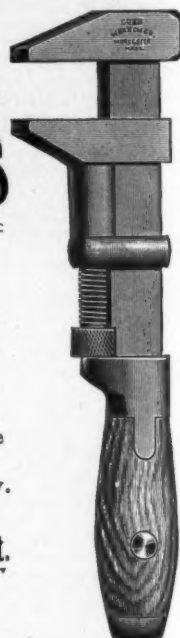
Patented Dec. 15, 1891, and April 30, 1895.

Sectional view illustrates our New Knife Handle  
showing manner of construction.

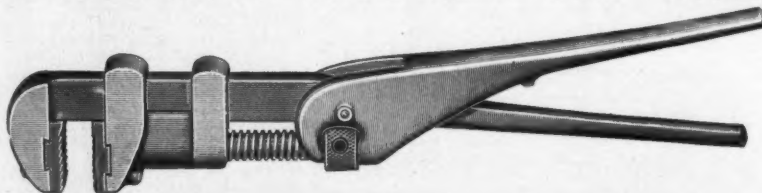
Straight Bar, Extra Long Nut, for Screw in Jaw.

The Best Made and Strongest Wrench in the Market.

J. C. McCARTY & CO., } Agents,  
JOHN H. GRAHAM & CO., }  
NEW YORK.



## THE STRONGEST PIPE AND NUT WRENCH.



This Wrench has become a general favorite among Plumbers, Steam Fitters and Jobbers generally. Every one sold helps to sell others. SEND FOR CIRCULAR AND PRICES.

**WRIGHT WRENCH CO., Worcester, Mass.**

## CHICAGO GRAIN DOOR COMP'Y RABBETED GRAIN DOORS.

"The only obstructions permitted inside a modern box car are  
**GRAIN DOOR RODS."**

Why not remove this objection by using

## THE CHICAGO RABBETED GRAIN DOOR.

**RICHARDSON & ALLEN-RICHARDSON BALANCED SLIDE VALVES.**

New Patent, April, 1891.

6,000 LOCOMOTIVES EQUIPPED. IN USE  
ON 175 RAILROADS.

Manufactured only by M. C. HAMMETT,  
SUCCESSOR TO

Estate of F. W. RICHARDSON, Troy, N. Y.



Butte, Anaconda & Pac. Ry. 4-8½ g. 42 m. 15 l. 1,400 c.  
M. Donahoe, *Gen. Man. & P. A.* Anaconda, Mont.  
A. Harrity, *M. M. & C. B.* Anaconda, Mont.

## C

Calumet & Blue Island Ry.  
Camden & Atlantic R. R. (See Penna. R.R.)  
Canada Atlantic Ry. 4-8½ g. 134.8 m. 25 l. 2,263 c.  
E. J. Chamberlin, *G. M. & P. A.* Ottawa, Ont.  
M. Donaldson, *S. & M. M. & C. B.* Ottawa, Ont.  
Canadian Pacific Ry.  
4-8½ g. 7,219.1 m. 615 lo. 675 pass. 15,769 frt. c.  
Sir W. C. Van Horne, *Pres.* Montreal, Can.  
R. Atkinson, *Mech. Supt.* Montreal, Can.  
Wm. Apps, *Gen. M. C. B.* Montreal, Can.  
A. C. Henry, *Pur. Agt.* Montreal, Can.  
Atlantic Div.:  
H. P. Timmermann, *Gen. Supt.* St. John, N.B.  
McAdam, N. B.  
E. Div.: C. W. Spencer, *Gen. Supt.* Montreal, Can.  
J. Elliott, *M. M.* Carleton, Ont.  
W. Div.: Wm. White, *Gen. Supt.* Winnipeg, Man.  
W. Cross, *M. M.* Winnipeg, Man.  
O. & Q. Div.:  
J. W. Leonard, *Gen. Supt.* Toronto, Ont.  
George McKinnon, *M. M.* Toronto, Ont.  
G. S. Mackinnon, *M. M.* Farnham, Que.  
Pac. Div.: H. Abbott, *Gen. Supt.* Vancouver, B. C.  
L. R. Johnson, *M. M.* Vancouver, B. C.  
Cape F. & Yackin, V. R. R. 4-9 g. 339 m. 26 lo. 311 c.  
John Gill, *Rec.* Baltimore, Md.  
J. W. Fry, *Gen. Man. & P. A.* Greensboro, N. C.  
I. W. Clark, *M. M. & C. B.* Fayetteville, N. C.  
Carolina Central. 4 g. 267 m. 24 l. 354 c.  
J. C. Winder, *Gen. Man.* Portsmouth, Va.  
L. T. Myers, *Gen. Supt. & P. A.* Portsmouth, Va.  
Carolina Midland R. R. 4-8½ g. 55 m. 4 lo. 30 cars.  
J. C. Keys, *G. S. P. A. & M. M.* Blackville, S. C.  
Carrabelle, Tallahassee & Georgia R. R.  
4-8½ g. 60 m. 31 l. 60 cars.  
S. D. Chittenden, *Gen. Man. & Pur. Agt.*  
Tallahassee, Fla.  
S. A. Shephard, *M. M.* Lanark, Fla.  
Carson & Colorado Ry. 3 g. 299 m. 8 lo. 227 cars.  
H. M. Yerington, *P. & G. S.* Carson City, Nev.  
Hume Yerington, *Pur. Agt.* Carson City, Nev.  
W. L. Wooley, *M. M.* Hawthorne, Nev.  
C. A. Brulin, *M. C. B.* Carson City, Nev.  
Carthage & Adirondack Ry.  
(See N. Y. C. & H. R. R. Co.)  
Central Branch Union Pac. (See Mo. Pac.); (3) Div.  
Central & Chester R. R. 4-8½ g. 67m. 5 l. 210  
R. H. Rosborough, *Gen. Man.* Sparta, Ill.  
G. W. Bartlett, *Asst. G. M. & Pur. Agt.*  
Sparta, Ill.  
P. W. Croak, *M. M.* Sparta, Ill.  
Central New York & Western R. R.  
4-8½ g. 3 g. 16m. stand. & 18m. narrow g. 11lc. 19c.  
M. S. Blair, *Gen. Supt.* Hornellsville, N. Y.  
L. B. Heers, *M. M.* Angelica, N. Y.  
Central Ontario Ry. 4-8½ g. 104 m. 8 lo. 125c.  
Geo. Collins, *Gen. Supt. & P. A.* Trenton, Ont.  
D. Duff, *M. M. & C. B.* Trenton, Ont.  
Central Pac. R. R. See Southern Pacific Co.  
Central Penn. & Western R. R. 4-9 g. 31 m. 2 lo. 9c.  
S. B. Haupt, *G. M. & P. A.* Watsontown, Pa.  
Central of Georgia Ry. Co.  
4-9 g. 1,462 m. 211 lo. 5,401 cars.  
T. D. Kline, *Gen. Supt.* Savannah, Ga.  
J. W. Comer, *Pur. Agt.* Savannah, Ga.  
T. B. Irvin, *M. M.* Savannah, Ga.  
So. West'n Div.: B. C. Epperson, *Supt.* Macon, Ga.  
John Dempsey, *M. M.* Macon, Ga.  
J. L. Whitsitt, *M. M.* Columbus, Ga.  
S. A. Charplot, *M. C. B.* Macon, Ga.  
W. H. Stubb, *M. M.* Augusta, Ga.  
Central R. R. of New Jersey.  
Operating Cumb. & Maurice River and Lehigh &  
Lackawanna roads. 4-8½ g. 637 m. 44 l. 29,595 c.  
J. H. Olhausen, *Gen. Supt.* Jersey City, N. J.  
G. D. W. Smith, *Pur. Agt.* Jersey City, N. J.  
C. A. Thompson, *Supt. M. P.* Jersey City, N. J.  
N. J. Cent. Div.:  
W. H. Peddle, *Supt.* Jersey City, N. J.  
W. L. Hoffecker, *M. M.* Elizabethport, N. J.  
N. J. South. Div.:  
W. V. Clark, *Supt.* Long Branch, N. J.  
W. Montgomery, *M. M.* Manchester, N. J.  
L. & S. Div.:  
G. W. Twining, *Supt.* Mauch Chunk, Pa.  
J. G. Thomas, *Supt. I. M. P.* Ashley, Pa.  
Central R. R. of S. C. (See Atlantic Coast Line.)  
Central Texas & N. W. R. R. (See Hou. & Tex. Cen.)  
Central Vermont R. R. 4-8½ g. 796 m. 200 lo. 4,314 c.  
E. C. Smith, *Chas. M. Hays, Recovers.*  
St. Albans, Vt.  
F. W. Baldwin, *Gen. Supt.* St. Albans, Vt.  
W. B. Hatch, *Pur. Agt.* St. Albans, Vt.  
C. E. Fuller, Jr., *Supt. M. P.* St. Albans, Vt.  
W. J. Robertson, *M. C. B.* St. Albans, Vt.  
Rut. Div.: J. Burdett, *Supt.* Rutland, Vt.  
G. W. Kinney, *M. M.* Rutland, Vt.  
New London No. R. R. 121 m. 24 lo. 382 c.  
D. Mackenzie, *Supt.* New London, Ct.  
J. Hinchey, *M. M.* New London, Ct.  
L. Beckwith, *M. C. B.* New London, Ct.  
Og. & L. Cham. Div.: 4-8½ g. 118m. 28 l. 1,583 c.  
Frank Owen, *Supt.* Ogdensburg, N. Y.  
Thos. Rumney, *Div. M. M.* Malone, N. Y.  
Charleston & Savannah. (See Plant System.)  
Charleston Sumt. & No. R. R. 4-9 g. 153m. 11 lo. 306 c.  
C. Millard, *Supt. & Pur. Agt.* Sumter, S. C.  
M. M. Sumter, S. C.  
Charleston & Western Carolina Ry. Co.  
4-9 g. 340 m. 25 lo. 154 c.  
A. W. Anderson, *Supt. & P. A.* Augusta, Ga.  
W. H. Stubb, *M. M. & C. B.* Augusta, Ga.  
Charlotte, Columbia & Augusta R. R. (See S. Ry. Co.)  
Chattanooga Southern Ry. 4-8½ g. 95 m. 6 lo. 228 c.  
M. F. Bonzano, *Gen. Man.* Chattanooga, Tenn.  
H. T. Ellison, *M. M.* Chattanooga, Tenn.  
H. P. Eager, *Pur. Agt.* Chattanooga, Tenn.  
Chat. R. R. & Colum. Ry. 4-9 g. 138 m. 9 lo. 79 c.  
E. E. Jones, *Rec. & Pur. Agt.* Rome, Ga.  
W. A. Love, *M. M. & C. B.* Rome, Ga.

Chateaugay R. R. 3 g. 73 m. 11 lo. 503 cars.  
J. N. Stower, *G. M. & Pur. A.* Plattsburg, N. Y.  
A. W. Fee, *M. M. & C. B.* Lyon Mountain, N. Y.  
Chesapeake & Ohio Ry. 4-9 g. 1,444 m. 355 l. 14,020 c.  
Geo. W. Stevens, *Gen. Man.* Richmond, Va.  
W. F. La Bonta, *Pur. Agt.* Richmond, Va.  
W. S. Morris, *Supt. M. P.* Richmond, Va.  
T. S. Lloyd, *M. M.* Richmond, Va.  
A. F. Stewart, *M. M.* Huntington, W. Va.  
Chesapeake, Ohio & Southwestern R. R.  
(See Ill. Cent. R. R.)  
Chester & Lenoir Ry. 3 g. 110 m. 7 lo. 128 cars.  
G. W. F. Harper, *Pres. & Rec.* Lenoir, N. C.  
L. T. Nichols, *Supt. & P. A.* Chester, S. C.  
Chicago & Alton R. R. 4-8½ g. 863 m. 240 lo. 7,804 c.  
U. H. Chappell, *P. & Gen. Man.* Chicago, Ill.  
A. V. Hartwell, *Pur. Agt.* Chicago, Ill.  
J. Johann, *S. Mch.* Bloomington, Ill.  
J. Townsend, *M. C. B.* Bloomington, Ill.  
Chicago & Calumet Terminal Ry. Co.  
(See Chicago & Northern Pacific R. R.)  
Chicago & Erie R. R. (See Erie R. R.)  
Chicago & Eastern Illinois R. R.  
4-8½ g. 502 m. 138 lo. 8,780 c.  
E. P. Broughton, *Gen. Supt.* Chicago, Ill.  
G. J. Schappert, *Pur. Agt.* Chicago, Ill.  
Thos. A. Lawes, *S. M. P. & M. Danville, Ill.*  
Chicago, Ft. Madison & Des Moines R. R.  
4-8½ g. 71 m. 3 lo. 28 c.  
E. F. Potter, *Gen. Man. & P. A.* Ft. Madison, Ia.  
Chicago & Gr. Trunk and Det. Jr. Haven & Mil. Ry.;  
Cincinnati, Saginaw & Mackinaw R. R.; Toledo,  
Saginaw & Muskegon R. R.  
4-8½ g. 763 m. 206 lo. 3,883 cars.  
(See Grand Trunk Ry.)  
Chicago & Iowa R. R. (See C. B. & Q.)  
Chicago, Lake Shore & Eastern Ry.  
4-8½ g. 366.17 m. 58 lo. 2,914 cars.  
W. G. Brinson, *Gen. Man.* Chicago, Ill.  
L. D. Doty, *Pur. Agt.* Chicago, Ill.  
C. J. Clifford, *M. M.* So. Chicago, Ill.  
E. B. Smith, *M. C. B.* So. Chicago, Ill.  
Chicago & Northern Pacific R. R.  
4-8½ g. 123.55m. 241. 116 cars.  
A. L. Hopkins, *Rec.* Chicago, Ill.  
S. R. Ainslie, *Gen. Man.* Chicago, Ill.  
W. B. Mallette, *Pur. Agt.* Chicago, Ill.  
J. McNaughton, *Supt. M. P.* Waukegan, Wis.  
C. L. Quimby, *M. M.* Chicago, Ill.  
Chicago & Northwestern Ry.  
4-8½ g. 5,030.78 m. 1,010 lo. 35,894 cars.  
John M. Whitman, *Gen. Man.* Chicago, Ill.  
Chas. Hayward, *Pur. Agt.* Chicago, Ill.  
Robt. Quayle, *Supt. M. P. & M.* Chicago, Ill.  
C. A. Schroyer, *S. C. D.* Chicago, Ill.  
Wis. Div.: Thos. A. Lawson, *Supt.* Chicago, Ill.  
J. Heath, *M. M.* Chicago, Ill.  
Gal. Div.: J. C. Stuart, *Supt.* Chicago, Ill.  
R. Erskine, *M. M.* Chicago, Ill.  
Penn. Div.: W. B. Linsley, *Supt.* Escanaba, Mich.  
J. W. Clark, *M. M.* Escanaba, Mich.  
Mad. Div.: R. A. Cowan, *Supt.* Baraboo, Wis.  
H. D. Page, *M. M.* Baraboo, Wis.  
W. & St. P. Div.:  
W. P. Cosgrave, *Supt.* Winona, Minn.  
Wm. McIntosh, *M. M.* Winona, Minn.  
Ia. Div.: P. Hallenbeck, *Supt.* Boone, Ia.  
J. Cockfield, *M. M.* Clinton, Ia.  
No. Iowa Div.: R. H. Aishton, *Supt.* Eagle Grove, Ia.  
Wm. Hutchinson, *Foreman.* Eagle Grove, Ia.  
Ashland Div.:  
C. H. Hartley, *Supt.* Kaukauna, Wis.  
A. W. McLean, *M. M.* Kaukauna, Wis.  
Dak. Div.: J. S. Oliver, *Supt.* Huron, S. D.  
F. M. Dean, *Foreman.* Huron, S. D.  
Chicago, Peoria & St. Louis R. R. of Illinois.  
4-8½ g. 225 m. 33 lo. 1,615 cars.  
C. H. Bosworth, *P. P. & G. M.* Springfield, Ill.  
F. C. Dadds, *Pur. Agt.* Springfield, Ill.  
W. J. Hemphill, *M. M. & C. B.* Jacksonville, Ill.  
Chicago & West. Michigan.  
4-8½ g. 574 m. 76 lo. 2,914 cars.  
Chas. M. Heald, *G. M.* Grand Rapids, Mich.  
Russell Wallace, *Pur. Agt.* Grand Rapids, Mich.  
B. Haskell, *S. M. P.* Grand Rapids, Mich.  
W. K. Christie, *M. M.* Muskegon, Mich.  
Chicago, Bur. & Kan. City Ry. (See C. B. & Q.)  
Chicago, Burlington & Northern R. R.  
4-8½ g. 371 m. 58 lo. 3,420 c.  
J. R. Hastings, *Gen. Supt.* St. Paul, Minn.  
Geo. Hargreaves, *Pur. Agt.* Chicago, Ill.  
W. H. Lewis, *M. M.* La Crosse, Wis.  
Chicago, Burlington & Quincy R. R.  
4-8½ g. 2,175 m. 546 lo. 24,078 cars.  
W. C. Brown, *Gen. Man.* Chicago, Ill.  
Geo. Hargreaves, *Pur. Agt.* Chicago, Ill.  
G. G. Yeomans, *Asst. P. A.* Chicago, Ill.  
G. W. Rhodes, *Supt. M. P.* Aurora, Ill.  
W. Forsyth, *Mech. Eng.* Aurora, Ill.  
K. D. Smith, *M. M.* Chicago, Ill.  
Chi. Div.: H. D. Judson, *Supt.* Aurora, Ill.  
A. Forsyth, *M. M.* Aurora, Ill.  
Galesburg Div.:  
W. B. Throop, *Supt.* Galesburg, Ill.  
R. W. Colville, *M. M.* Galesburg, Ill.  
St. L. Div.: W. G. Besler, *Supt.* Beardstown, Ill.  
C. W. Eckerson, *M. M.* Beardstown, Ill.  
Ia. & Mo. Lines: C. M. Levey, *Supt.* Burlington, Ia.  
J. West, *M. M.* Burlington, Ia.  
East. Div.: O. E. Stewart, *Supt.* Ottumwa, Ia.  
J. F. Deems, *M. M.* Ottumwa, Ia.  
Joel West, *M. M.* West Burlington, Ia.  
West'n Div.: J. H. Duggan, *Supt.* Creston, Ia.  
E. Jones, *M. M.* Creston, Ia.  
Bur. & Mo. R. R. in Neb.:  
4-8½ g. 3,515.4 m. 333 lo. 8,419 cars.  
G. W. Holdrege, *Gen. Man.* Omaha, Neb.  
D. Hawksworth, *Supt. M. P.* Plattsmouth, Neb.  
E. S. Grousel, *M. M.* Havelock, Neb.  
R. T. Smith, *M. M.* Lincoln, Neb.  
A. B. Pirie, *M. M.* Winmore, Neb.  
R. B. Archibald, *M. M.* McCook, Neb.  
J. P. Reardon, *M. M.* Alliance, Neb.  
Chicago, Iowa & Dakota Ry. 4-8½ g. 27 m. 2 l. 18 c.  
W. B. Porter, *Gen. Man. & Pur. A.* Eldora, Ia.  
Thos. D. McDonald, *M. M.* Eldora, Ia.

Chicago, Kalamazoo & Saginaw Ry.  
4-8½ g. 45 m. 4 lo. 17 cars.  
James H. Dewing, *V. P. & Gen. Man.*  
Kalamazoo, Mich.

Chicago, Milwaukee & St. Paul Ry.  
4-8½ g. 6,154m. 852 lo. 28,965 cars.  
A. J. Earling, *V. P. & Gen. Man.* Chicago, Ill.  
J. T. Crocker, *Pur. Agt.* Chicago, Ill.  
J. N. Barr, *Supt. M. P. & C. D.* Milwaukee, Wis.  
A. E. Manchester, *A. S. M. P.* Milwaukee, Wis.  
Geo. Gibbs, *Mech. Eng.* Milwaukee, Wis.  
J. J. Hennessey, *M. C. B.* Milwaukee, Wis.  
Geo. H. Brown, *M. M.* Dubuque, Ia.  
John Taylor, *M. M.* Minneapolis, Minn.  
N. S. Kimball, *M. M.* Green Bay, Wis.  
Chicago, Paducah & Memphis R. R.  
4-8½ g. 105 m. 6 lo. 1,425 cars.  
B. F. Johnston, *Gen. Man.* St. Elmo, Ill.  
P. M. Johnston, *Pur. Agt.* St. Elmo, Ill.  
W. W. Eggleston, *M. M.* St. Elmo, Ill.  
G. W. House, *M. C. B.* St. Elmo, Ill.  
Chicago, Rock Island & Pac. Ry.  
4-8½ g. 3,574.1 m. 506 lo. 16,839 cars.  
W. H. Truesdale, *3d V. P. & G. M.* Chicago, Ill.  
F. A. Marsh, *Pur. Agt.* Chicago, Ill.  
Geo. F. Wilson, *S. M. P.* Chicago, Ill.  
L. T. Canfield, *M. C. B.* Chicago, Ill.  
Lines East of Missouri River:  
Ill. Div.: C. L. Nichols, *Supt.* Blue Island, Ill.  
J. W. Fitzgibbon, *M. M.* Chicago, Ill.  
A. Childs, *M. C. B.* Chicago, Ill.  
East Iowa Div.:  
Wm. H. Stocks, *M. M.* Rock Island, Ill.  
Ia. Div.: H. Fox, *Supt.* Des Moines, Ia.  
J. B. Kilpatrick, *M. M.* Valley Junction, Ia.  
Des. M. Val. Div.: C. N. Gilmore, *Supt.* Des Moines, Ia.  
J. B. Kilpatrick, *M. M.* Valley Junction, Ia.  
So. Wn. Div.: W. J. Lawrence, *Supt.* Trenton, Mo.  
A. L. Studer, *M. M.* Trenton, Mo.  
Lines West of Missouri River:  
H. Monkhouse, *A. S. M. P. & E. Horton, Kan.*  
Chicago, St. Louis & Pittsburgh R. R. (See Penn. Co.)  
Chicago Great Western Ry.  
4-8½ g. 928 m. 147 l. 4,975 c.  
Samuel C. Stickney, *Gen. Man.* St. Paul, Minn.  
A. D. Ward, *Pur. Agt.* St. Paul, Minn.  
Tracy Lyor, *M. M.* St. Paul, Minn.  
Chicago, St. Paul, Minneapolis & Omaha Ry.  
4-8½ g. 1,492 m. 269 lo. 9,595 cars.  
Walter A. Scott, *Gen. Man.* St. Paul, Minn.  
W. H. S. Wright, *Pur. Agt.* St. Paul, Minn.  
J. J. Ellis, *M. M.* St. Paul, Minn.  
H. L. Preston, *M. C. B.* Hudson, Wis.  
Chicago & South Eastern Ry. 4-8½ g. 110m. 11 lo. 100c.  
H. Crawford, Jr., *Gen. Man. & Pur. Agt.*  
Chicago, Ill.  
J. W. Roberts, *M. M.* Lebanon, Ind.  
Chicago & Texas R. R. Co.  
4-8½ g. 74½ m. 12 lo. 300 cars.  
O. L. Garrison, *V. P.* St. Louis, Mo.  
S. L. Sherer, *Pur. Agt.* St. Louis, Mo.  
Geo. W. Underhill, *For. Car Shops.*  
Murphysboro, Ill.  
Chicago & Western Indiana R. R. Co. and The Belt  
Ry. Co. of Chicago.  
4-8½ g. 55 m. 45 l. 150 cars.  
B. Thomas, *Pres. & Gen. Man.* Chicago, Ill.  
C. C. Nash, *Pur. Agt.* Chicago, Ill.  
F. H. Peck, *M. M.* Chicago, Ill.  
Choctaw Oklahoma & Gulf Ry.  
4-8½ g. 219 m. 15 lo. 1,350 cars.  
Henry Wood, *Gen. Man.* So. McAlester, I. T.  
H. E. Yarnall, *Pur. Agt.* So. McAlester, I. T.  
J. Cunningham, *M. M. & C. B.*  
So. McAlester, I. T.  
Cincinnati & Kentucky Southern Ry.  
4-8½ g. 13 m. 2 lo. 51 c.  
E. Ritchie, *Gen. Man. & P. A.* Cincinnati, O.  
W. L. Peairs, *M. M.* Yosemite, Ky.  
Cin. & Muskingum Valley Ry.  
4-9 g. 148.45 m. 20 l. 394 c.  
C. M. Bennett, *Supt.* Zanesville, O.  
H. O. Hukill, *Pur. Agt.* Pittsburgh, Pa.  
Wm. Meikle, *Genl. For. Shops.* Lancaster, O.  
Cincinnati & Northwestern R. R.  
4-8½ g. 14 m. 2 lo. 40 cars.  
R. Simpson, *Gen. Man. & Pur. Agt.* Cincinnati, O.  
O. K. Simpson, *M. M.* Cincinnati, O.  
Cincinnati & Westwood R. R. 4-8½ g. 9 m. 2 lo. 9 c.  
J. N. Gamble, *G. M. & P. A.* Cincinnati, O.  
Cin., Georgetown & Portsmouth Ry. 3 g. 42 m. 5 lo. 80 c.  
E. W. White, *G. M. & Pur. Agt.* Cincinnati, O.  
J. M. Myers, *Supt.* Cincinnati, O.  
P. T. Dunn, *F. of Shops & M. C. B.* Cincinnati, O.  
Cincinnati, Hamilton & Dayton; Dayton & Mich.:  
Cin., Ham. & Ind.; Columbus, Findlay & North-  
ern; Bowling Green, Cincinnati & Dayton R. R's.  
4-8½ g. 651.6 m. 167 l. 8,271 cars.  
Chas. G. Waldo, *Gen. Man.* Cincinnati, O.  
G. B. Balch, *Pur. Agt.* Cincinnati, O.  
C. H. Cory, *Supt. M. P.* Lima, O.  
H. H. Swift, *Gen. Car. For.* Lima, O.  
A. J. Ball, *Div. M. M.* Dayton, O.  
J. M. Percy, *Div. M. M.* Cincinnati, O.  
Cincinnati, Jackson & Mackinaw Ry.  
4-8½ g. 403 m. 30 lo. 1,435 cars.  
F. B. Drake, *Rec. & Gen. Man. & P. A.* Toledo, C.  
A. H. Watts, *M. M.* Van Wert, O.  
Cin., Leb. & North. Ry. 4-8½ g. 31.1 m. 6 l. 55 c.  
Jos. Wood, *Gen. Man.* Cincinnati, O.  
Ralph Peters, *Supt. & Pur. Agt.* Cincinnati, O.  
Jos. Underwood, *M. M. & C. B.* Cincinnati, O.  
Cincinnati, New Orleans & Texas Pacific Ry. Co.  
4-8½ g. 333 m. 103 l. 4,005 cars.  
S. M. Felton, *Pres. & Rec.* Cincinnati, O.  
Geo. W. Stevens, *Supt. Car Service & P. A.*  
Somerset, Ky.  
J. P. McCuen, *Supt. M. P.* Ludlow, Ky.  
Cincinnati, Portsmouth & Virginia R. R.  
4-8½ g. 112 m. 13 lo. 185 cars.  
Sam'l Hunt, *Pres. & Gen. Man.* Cincinnati, O.  
T. Hunt, *Pur. Agt.* Cincinnati, O.  
John C. Homer, *M. M. & C. B.* Portsmouth, O.  
Cincinnati, Richmond & Chi. R. R. (See C. St. L. & P.)

**RAILWAY CAR CONSTRUCTION.**

The Only Perfect Work on American Cars Ever Published.

WRITTEN AND COMPILED BY  
**WILLIAM VOSS.**

200 Pages.

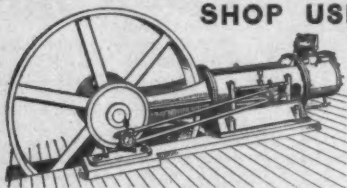
Upward of 500 Engravings.

Price, Postage Prepaid, \$3.00 per Copy.

Remit by Bank Check, Express Money Order,  
P. O. Money Order or Registered Letter.

**COMPRESSORS**

ESPECIALLY DESIGNED FOR  
SHOP USE.



Send for Catalogue.

**RAND DRILL CO.**

100 BROADWAY, NEW YORK.

**STOW FLEXIBLE SHAFT**

Invented and  
Manufactured  
by the

**Stow  
Mfg.  
Co.,**

BINGHAMTON, N.Y.

Established  
in 1875.

For Tapping and Reaming  
Stay Bolt Holes in . . .

**BOILERS**  
Portable Drilling.

**SPRINGFIELD LINE**

BETWEEN

**BOSTON AND NEW YORK.**  
FIVE SOLID THROUGH EXPRESS TRAINS.

Leave both cities at 9:00 A. M. daily except  
Sunday; 11:00 A. M. daily except Sunday;  
4:00 P. M. daily; 11:00 P. M. daily.

Drawing room cars on day trains, sleeping  
cars on night trains.

A. S. HANSON, Gen'l Pass. Agt.

**QUEEN & CRESCENT ROUTE**  
*The Florida & New Orleans Limited*  
A SUPERB VESTIBULE TRAIN  
CINCINNATI AND ST. AUGUSTINE, FLA.  
LEXINGTON, CHATTANOOGA, ATLANTA, JACKSONVILLE  
NO EXTRA FARES ON THESE TRAINS  
SOLID VESTIBULE TRAIN  
CINCINNATI AND NEW ORLEANS  
LEXINGTON, CHATTANOOGA, AND BIRMINGHAM  
ONLY LINE RUNNING THROUGH SLEEPING CARS  
BETWEEN  
CINCINNATI & ASHEVILLE, N.C.  
*"The Blue Grass Special"*  
FREE PARLOR CARS  
CINCINNATI AND LEXINGTON.

**YELLOW PINE CAR SILLS.**

OAK, CYPRESS, ASH, POPLAR AND WHITE PINE

**RAILROAD TIES**

CREOSOTED LUMBER, TIMBER, TIES AND SPILES  
VANDERBILT & HOPKINS, 126 Liberty St., New York.

**LAP JOINT**

—FOR—

**STEAM BOILERS**

—AND—

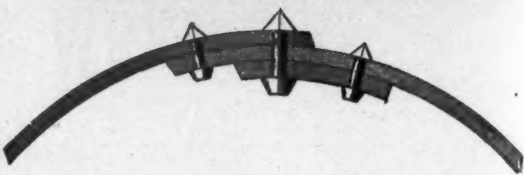
**RADIAL TAPS**

FOR LONG DISTANCES

And to Suit Any Size.

ADDRESS

**J. T. CONNELLY,**  
MILTON, PA.



SOLE MANUFACTURERS OF **FRED C. WEIR'S**  
IMPROVED RIGID & SPRING FROGS, CROSSINGS  
SINGLE & THREE THROW SPLIT SWITCHES.  
FIXED & AUTOMATIC SWITCH STANDS, STEEL  
DIE FORMED RAIL BRACES, SWITCH FIXTURES, ETC.

**CABLE & ELECTRIC  
TRACK WORK  
FROGS, SWITCHES,  
CROSSINGS, CURVES,  
RAIL CHAIRS  
ETC.**

**THE THURMAN FUEL OIL BURNER COMPANY**

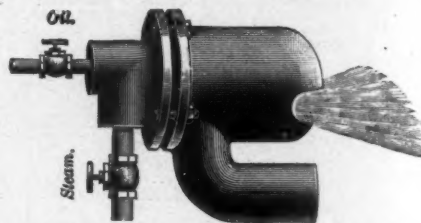
Designers, Contractors and Engineers for Complete Fuel Oil Equipments.

GENERAL OFFICES: **31 & 32 Cordova Building,  
INDIANAPOLIS, IND.**

For Boilers, Furnaces, Ovens,  
Forges, Dryers, Etc. : : :  
Acknowledged the best. Absolutely Smokeless.



Hot Air from Furnace.  
BURNER NO. 6.



Hot Air from Furnace.

BURNER NO. 4.

BRANCHES—1401 Monadnock Block, Chicago, Ill.  
21 & 23 Fremont St., San Francisco, Cal.

NOTE.—If you are using oil as fuel and are not getting good results, we would be pleased to send you our burners, on trial. The oil in our burners can be atomized by either steam or air.

Write for Catalogue.

**RAILWAY CAR CONSTRUCTION.**

200 PAGES. 500 ENGRAVINGS. By **WILLIAM VOSS.**

With Full Working Drawings of Every Style

of Car Now Used on American Railroads. . .

Address . . **American Engineer Car Builder and Railroad Journal,**  
—MORSE BUILDING, NEW YORK.

Cincinnati, Saginaw & Mackinaw R. R.  
(See C. & G. T. Ry. Co.)  
Cin., Wabash & Mich. Ry. (See C. C. & S. L. R. R.)  
Clarendon & Pittsford Ry. 4-8 1/2 g. 12 m. 31. 113 c.  
F. D. Proctor, Gen. Mgr. Proctor, Vt.  
G. H. Davis, M. M. Proctor, Vt.  
E. J. Boyce, Pur. Agt. Proctor, Vt.  
Cleveland, Akron & Columbus Ry.  
4-9 g. 177 m. 42 lo. 2,946 cars.  
Calvin S. Brice, Pres. Cleveland, O.  
T. H. Perry, Pur. Agt. Indianapolis, Ind.  
B. F. Marshall, M. M. & M. C. B.  
Mt. Vernon, O.  
Cleve., Cant. & South R. R. 4-8 1/2 g. 210 m. 37 1/2. 708 c.  
J. W. Wardwell, Rec. & Man. Cleveland, O.  
H. A. Kennedy, Gen. Supt. & P. A. Canton, O.  
John Bean, M. M. & M. C. B. Canton, O.  
Cleveland & Marietta Ry. 4-8 1/2 g. 104.7 m. 19 1/2. 1,012 c.  
W. A. Baldwin, Pres. G. M. & P. A. Cambridge, O.  
J. Glasser, M. M. & M. C. B. Cambridge, O.  
Cleveland & Pittsburgh.  
(See Penna. Co.)  
Clev., Cinn., Chi. & St. Louis:  
4-8 1/2 g. 2,345 m. 528 lo. 14,720 cars.  
C. E. Schaff, Gen. Man. Cincinnati, O.  
A. M. Stimson, Pur. Agt. Cincinnati, O.  
William Garstang, Supt. M. P. Indianapolis, Ind.  
Cinn.-Sandusky Div.:  
Thos. J. English, Supt. Springfield, O.  
James A. Keegan, M. M. Delaware, O.  
Clev. & Indianapolis Div.:  
T. J. Higgins, Supt. Cleveland, O.  
E. E. Hudson, M. M. Bellefontaine, O.  
St. Louis Div.:  
E. M. Neel, Supt. Mattoon, Ill.  
G. S. McKee, M. M. Mattoon, Ill.  
Chicago Div.:  
G. W. Bender, Supt. Indianapolis, Ind.  
F. W. Lawler, M. M. Brightwood, Ind.  
Cairo Div.:  
W. P. Orland, M. M. Mt. Carmel, Ill.  
P. & E. Ry.: J. A. Barnard, Gen. Man. Urbana, Ill.  
J. McClurg, M. M. Urbana, Ill.  
Mich. Div.: S. T. Blizard, Supt. Wabash, Ind.  
Frank J. Zerboe, M. M. Wabash, Ind.  
Cleveland, Lorain & Wheeling Ry.  
4-8 1/2 g. 192 m. 59 lo. 4,702 cars.  
W. R. Woodford, Gen. Man. Cleveland, O.  
F. E. Now, Pur. Agt. Cleveland, O.  
James A. Graham, M. M. Lorain, O.  
F. H. Stark, M. C. B. Lorain, O.  
Cleveland Terminal & Valley R. R.  
4-8 1/2 g. 76 m. 36 lo. 1,041 cars.  
J. T. Johnson, Gen. Supt. & Pur. Agt.,  
Cleveland, O.  
Colorado Eastern R. R. Co. 3 g. 17 m. 2 lo. 11 cars.  
C. M. Wicker, Gen. Man. Denver, Col.  
H. McDowell, Gen. Pur. Agt. Denver, Col.  
H. Twining, M. M. & M. C. B. Denver, Col.  
Colorado Midland Ry. 4-8 1/2 g. 233 m. 51 1/2. 1,415 c.  
(See A., T. & S. F. Rd.)  
Columbia & Greenville R. R. (Rich. & Danville.)  
Columbia & Puget Sound R. R.  
(See Oregon Improvement Co.)  
Columbus Southern Ry. 4-9 g. 88 m. 5 lo. 106 cars.  
T. E. Banchard, Receiver. Columbus, Ga.  
S. F. Parratt, Gen. Man. & Pur. Agt. Columbus, Ga.  
H. C. Hill, Supt. Columbus, Ga.  
J. McC. Hill, M. M. & M. C. B. Columbus, Ga.  
Columbus, Sandusky & Hocking R. R.  
4-8 1/2 g. 287 m. 50 lo. 3,770 c.  
W. E. Guerin, P. & G. Man. Sandusky, O.  
W. J. Miller, G. Foreman Mac. Dept.,  
Columbus, O.  
John Wohrle, G. For. Car Dept. Columbus, O.  
Columbus & Rome R. R. (See Cent. of Ga.)  
Columbus, Hocking Valley & Toledo Ry.  
4-8 1/2 g. 335 m. 114 lo. 7,700 cars.  
W. A. Mills, Gen. Man. Toledo, O.  
C. B. Duffy, Pur. Agt. Columbus, O.  
S. S. Stuffer, M. M. Columbus, O.  
Colusa & Lake R. R. 3 g. 22 m. 3 lo. 29 cars.  
E. A. Harrington, Man. Supt. & P. A. Colusa, Cal.  
M. E. Burrows, M. M. Colusa, Cal.  
T. Sullivan, M. C. B. Colusa, Cal.  
Concord & Montreal R. R.  
4-8 1/2 g. 530 m. 100 lo. 2,682 cars.  
(See Boston & Maine.)  
Conn. Riv. R. R. 4-8 1/2 g. 130 m. 55 lo. 688 c.  
(See Boston & Maine.)  
Cooperstown & Charlotte Valley R. R.  
4-8 1/2 g. 25 m. 3 lo. 25 cars.  
D. E. Silver, Pres. & Pur. Agt. Cooperstown, N. Y.  
A. Gardner, M. M. & M. C. B. Cooperstown, N. Y.  
Cornwall R. R. 4-8 1/2 g. 31.1 m. 5 lo. 9 pass. c.  
E. C. Freeman, Gen. Man. Lebanon, Pa.  
D. S. Hammond, Supt. & Pur. Agt. Lebanon, Pa.  
A. J. Reed, M. M. Lebanon, Pa.  
Levi Blouch, M. C. B. Lebanon, Pa.  
Cornwall & Lebanon.  
4-1/2 g. 22 m. 10 lo. 17 p. 540 ft. cars.  
A. D. Smith, Gen. Supt. & P. A. Lebanon, Pa.  
R. T. Spotten, M. M. Lebanon, Pa.  
Coudersport & Port Allegheny R. R.  
4-8 1/2 g. 45 1/2 m. 3 lo. 80 cars.  
B. A. McClure, G. Supt. & P. A. Coudersport, Pa.  
Cressen & Clearfield Counties and N. Y. Short Route  
(See Pennsylvania Ry.)  
Crooked Creek R. R. & Coal Co.  
4-8 1/2 g. 25 m. 2 lo. 23 cars.  
W. C. Willson, Pres. & Gen. Man.,  
Webster City, Ia.  
Cumberland & Maurice River Ry. (See Cent. Ry. of N. J.)  
Cumberland & Penn. R. R. 4-8 1/2 g. 55 m. 23 lo. 470 c.  
Lewis M. Hamilton, Gen. Supt. & P. A.,  
Cumberland, Md.  
H. T. Bruck, M. M. Mt. Savage, Md.  
Cumberland Valley R. R. 4-9 g. 166 m. 34 lo. 764 cars.  
J. F. Boyd, Supt. & P. A. Chambersburg, Pa.  
J. Lawrence, M. M. Chambersburg, Pa.  
C. Wicke, M. C. B. Chambersburg, Pa.  
D  
Danville & Western Ry. 3 g. 83 m. 5 lo. 70 c.  
A. B. Andrews, Pres. Raleigh, N. C.  
G. K. Griggs, Supt. & Pur. Agt. Danville, Va.

W. T. Whittaker, M. M. Danville, Va.  
Dayton & Michigan R. R. (See Cin., Ham. & Day.)  
Delaware & Hudson Canal Co.  
4-8 1/2 g. 689 m. 333 lo. 18,618 cars.  
H. G. Young, 2d V. Pres. Albany, N. Y.  
J. White Sprong, Pur. Agt. Albany, N. Y.  
R. C. Blackall, Supt. Mach. Albany, N. Y.  
Susq. Div.: C. D. Hammond, Supt. Albany, N. Y.  
J. R. Skinner, M. C. B. Oneonta, N. Y.  
H. O. Smith, M. M. Oneonta, N. Y.  
Sar. & C. Div.: C. D. Hammond, Supt. Albany, N. Y.  
J. L. Cory, M. M. Green Island, N. Y.  
Chr. Körner, M. C. B. Green Island, N. Y.  
Pa. Div.: C. R. Manville, Supt. Carbondale, Pa.  
C. F. Rettew, M. M. Carbondale, Pa.  
John H. Orchard, M. C. B. Carbondale, Pa.  
Del., Lackawanna & Western R. R.  
4-8 1/2 g. 901 m. 618 lo. 31,535 cars.  
Wm. F. Hallstead, Gen. Man. Scranton, Pa.  
W. D. Hager, Pur. Agt. New York, N. Y.  
D. Brown, Mast. Mach. Scranton, Pa.  
Robt. McKenna, M. C. B. Scranton, Pa.  
Utica Div.: A. C. Salisbury, Supt. Utica, N. Y.  
Thos. Thatcher, M. M. Utica, N. Y.  
Morris & Essex Div.: Sussex.  
A. Reasoner, Supt. Hoboken, N. J.  
W. H. Lewis, M. M. Kingdland, N. J.  
W. B. Baker, Mast. Car Rep. Dover, N. J.  
Oswego & Syracuse Div.:  
A. H. Schwarz, Supt. Syracuse, N. Y.  
L. Kistler, M. M. Syracuse, N. Y.  
Syracuse, Binghamton & New York Div.  
A. H. Schwarz, Supt. Syracuse, N. Y.  
Lewis Kistler, M. M. Syracuse, N. Y.  
Div.: J. B. Marston, Supt. Buffalo, N. Y.  
F. B. Griffith, M. M. Buffalo, N. Y.  
Delaware River R. R. 4-8 1/2 g. 20 m. 3 lo. 11 cars.  
W. S. Conner, Gen. Man. Woodbury, N. J.  
E. H. Green, Supt. & P. A. Pennsgrove, N. J.  
J. B. Gilbert, M. M. Pennsgrove, N. J.  
Denison & Washita Valley. 4-8 1/2 g. 14 m. 1 lo. 119 c.  
Thos. Fleming, Supt. Denison, Tex.  
Denver & Rio Grande Ry.  
3 and 4-8 1/2 g. 1,666.01 m. 292 lo. 7,969 c.  
E. T. Jeffery, Pres. & G. M. Denver, Col.  
Henry Schlacks, Supt. Mach. Denver, Col.  
C. M. Hobbs, Pur. Agt. Denver, Col.  
Delaware, Susquehanna & Schuylkill R. R. Co.  
4-9 g. 67.23 m. 29 lo. 1,521 cars.  
Luther C. Smith, Supt. Drifton, Pa.  
Arthur McClellan, P. A. Drifton, Pa.  
John R. Wagner, Act. Supt. M. P. Drifton, Pa.  
Des Moines & Kansas City Ry.  
3 g. 112 m. 9 lo. 212 cars.  
A. C. Goodrich, V. P. & G. M. Keokuk, Ia.  
W. Augustus, Supt. Mch. Keokuk, Ia.  
R. D. Lewis, Pur. Agt. Keokuk, Ia.  
Des Moines, Northern & Western R. R.  
4-8 1/2 g. 156 m. 14 lo. 212 cars.  
F. C. Hubbell, Supt. & P. A. Des Moines, Ia.  
W. H. Whittaker, M. M. & M. C. B.  
Des Moines, Ia.  
Detroit & Mackinac R. R.  
4-8 1/2 g. 253 m. 20 lo. 776 c.  
J. D. Hawks, V. P. & G. M. Detroit, Mich.  
J. M. Crocker, Pur. Agt. Detroit, Mich.  
H. T. Thomas, M. M. & M. C. B. E. Tawas, Mich.  
Det., Gr. H. & Mill Ry. (See Chi. & Gr. Trunk.)  
Det., Lansing & N. O. and Saginaw Valley & St.  
Louis Rys. 4-8 1/2 g. 378 m. 47 lo. 2,101 c.  
C. M. Heald, Receiver. Grand Rapids, Mich.  
R. Wallace, Pur. Agt. Grand Rapids, Mich.  
B. Haskell, Supt. M. P. Grand Rapids, Mich.  
Walter T. Rupert, M. M. Ionia, Mich.  
Dominion Atlantic Ry. 4-8 1/2 g. 234 m. 22 lo. 424 c.  
W. R. Campbell, Gen. Man. Kentville, N. S.  
K. Sutherland, Gen. Supt. & P. Agt.,  
Kentville, N. S.  
W. Yould, M. M. Kentville, N. S.  
W. Grierson, M. C. B. Koutville, N. S.  
Duluth, Red Wing & Southern.  
4-8 1/2 g. 28 m. 2 lo. 45 c.  
L. F. Hubbard, G. M. & Pur. Agt.,  
Red Wing, Minn.  
H. D. McKay, M. M. Red Wing, Minn.  
J. Lyons, M. C. B. Red Wing, Minn.  
Duluth & Iron Range R. R.  
4-8 1/2 g. 154 m. 52 1/2. 2,326 c.  
J. L. Groatinger, Gen. Man. & Pur. Agt.,  
Duluth, Minn.  
H. S. Bryan, M. M. & M. C. B.  
Two Harbors, Minn.  
Duluth, Miss'be & North'n. 4-8 1/2 g. 118.5 m. 26 lo. 1,483 c.  
J. W. Kreitzer, Supt. Duluth, Minn.  
S. R. Payne, Pur. Agt. Duluth, Minn.  
A. F. Priest, M. M. Duluth, Minn.  
Duluth, Mississippi River & Northern R. R.  
4-8 1/2 g. 65 m. 7 lo. 226 cars.  
J. F. Killorin, V. P., G. M. & Pur. Agt.,  
Swan River, Minn.  
D. McLean, M. M. & M. C. B.,  
Swan River, Minn.  
Duluth, South Shore & Atlantic Ry.  
4-8 1/2 g. 582.18 m. 95 lo. 3,428 c.  
W. F. Fitch, Gen. Man. Marquette, Mich.  
P. W. Brown, Pur. Agt. Marquette, Mich.  
J. J. Conolly, M. M. Marquette, Mich.  
D. C. Mulvihill, M. C. B. Marquette, Mich.  
Duluth & Winnipeg R. R.  
(See Canadian Pacific R. R.)  
Dunkirk, Allegheny Valley & Pittsburgh R. R.  
(N. Y. Cen. & H. R. R. Leassee)  
4-8 1/2 g. 91 m. 12 lo. 111 cars.  
Edgar Van Etten, Gen. Supt. Dunkirk, N. Y.  
Allen Boura, Pur. Agt. New York, N. Y.  
W. G. Taber, M. M. & M. C. B. Dunkirk, N. Y.  
E  
Eagles Mere Ry. Co. 3-6 g. 8 m. 2 lo. 26 cars.  
B. H. Welch, Gen. Man. & P. A.,  
Hughesville, Pa.  
John Converse, M. M. Hughesville, Pa.  
D. W. Darling, M. C. B. Hughesville, Pa.  
East Alabama Ry. (See Central of Ga.)

East & West R. R. 5-9 g. 120 m. 12 lo. 125 c.  
Chas. P. Ball, Man. & Pur. A. Cartersville, Ga.  
B. F. Lowther, M. M. & M. C. B. Cedartown, Ga.  
East Broad Top R. R. & Coal Co. 3 g. 45 m. 8 lo. 321 c.  
A. W. Greenwood, Supt. M. M. & P. A.,  
Rockhill Furnace, Pa.  
Eastern Kentucky Ry. 4-9 g. 36 m. 4 lo. 48 c.  
H. W. Bates, Gen. Man. & Pur. A. Greenup, Ky.  
A. W. Crawford, M. M. Grayson, Ky.  
Eastern Ry. Co. of Minnesota.  
(See Great Northern Ry.)  
East Tenn. & Western North Car. R. R.  
3 g. 34 m. 3 lo. 112 cars.  
C. H. Nimson, Gen. Supt. Cranberry, N. C.  
W. Hahn, Pur. Agt. Cranberry, N. C.  
M. W. Lindamood, M. M. Johnson City, Tenn.  
East Tennessee, Virginia & Georgia Ry.  
(See Southern Ry. Co.)  
Elgin, Joliet & Eastern Ry.  
4-8 1/2 g. 176 m. 47 lo. 2,000 cars.  
C. H. Ackert, Gen. Man. Joliet, Ill.  
R. A. Dugan, Pur. Agt. Chicago, Ill.  
John Horrigan, M. M. Joliet, Ill.  
E. T. Carlton, M. C. B. Joliet, Ill.  
Elgin & Havelock Ry. 4-8 1/2 g. 27 m. 2 lo. 12 c.  
J. D. Chipman, Man. & P. Agt. St. Stephen, N. B.  
A. H. Robinson, G. S. & P. A. Petitcodiac, N. B.  
W. W. Killam, M. M. & M. C. B. Petitcodiac, N. B.  
Elmira, Cortland & Northern R. R. Co.  
4-8 1/2 g. 140 m. 23 lo. 232 c. (See L. V. R. R.)  
Erie R. R.  
4-8 1/2 g. 2,061 m. 672 lo. 686 pass. c. 28,893 frt. c.  
E. B. Thomas, Pres. New York, N. Y.  
A. E. Mitchell, Supt. M. P. New York, N. Y.  
E. B. Sheffer, Pur. Agt. New York, N. Y.  
Erie R. R. Div.:  
C. R. Fitch, Gen. Supt. New York, N. Y.  
H. F. Baldwin, Eng. M. of W. Jersey City, N. J.  
East Div.: M. W. Maguire, Supt. Jersey City, N. J.  
H. A. Childs, M. M. Jersey City, N. J.  
Del. Div.: W. L. Derr, Supt. Port Jervis, N. Y.  
J. Haines, M. M. Port Jervis, N. Y.  
Susq. Div.: J. F. Maguire, Supt. Elmira, N. Y.  
I. Bond, M. M. Susquehanna, Pa.  
Buff. & S. W. Div.:  
C. A. Bruun, Supt. Buffalo, N. Y.  
J. H. Moore, M. M. Buffalo, N. Y.  
Robert Gunn, For. C. Rep. Buffalo, N. Y.  
Roch. Div.: G. A. Thompson, Supt. Rochester, N. Y.  
Frank Tuma, M. M. Rochester, N. Y.  
W'n Div.: H. E. Gilpin, Supt. Hornellsville, N. Y.  
C. P. Weiss, M. M. Hornellsville, N. Y.  
Tioga Div.: E. E. Loomis, Supt. Elmira, N. Y.  
Bradford Div.: C. V. Merrick, S. Bradford, Pa.  
C. P. Weiss, M. M. Bradford, Pa.  
N. Y. & Greenwood L. Ry.  
4-8 1/2 g. 51 m. 1 lo. 23 pass. c. 20 frt. c.  
B. H. Moody, Supt. Jersey City, N. J.  
N. R. R. of N. J. Div.: 4-8 1/2 g. 28 m. 20 p. c.  
B. E. Moody, Supt. Jersey City, N. J.  
N. Y. Pa. & O. Div.  
4-8 1/2 g. 599 m. 247 lo. 141 pass. c. 9,442 frt. c.  
J. C. Moorhead, Gen. Supt. Cleveland, O.  
W. Lavery, Act. Supt. M. P. Cleveland, O.  
1st & 2d Div.: I. Beiman, Supt. Meadville, Pa.  
George Donahue, M. M. Meadville, Pa.  
3d & 4th Divs.: C. A. Allen, Supt. Gallon, O.  
A. W. Ball, M. M. Gallon, O.  
Maho'g Div.: H. N. Donaldson, Supt. Youngstown, O.  
Willard Kells, M. M. Cleveland, O.  
Erie & Huron Ry. 4-8 1/2 g. 74 m. 51.54 c.  
J. J. Ross, Gen. Man. & P. A. Chatham, Ont.  
F. Stamelen, M. M. Chatham, Ont.  
Erie & Pittsburgh R. R. (See Penna. Co.)  
Erie & Wyoming Valley R. R. 4-8 1/2 g. 78.23 m. 39 lo. 1,286 c.  
Geo. B. Smith, Supt. & Pur. Agt. Dunmore, Pa.  
D. E. Barton, M. M. Dunmore, Pa.  
S. D. King, M. C. B. Dunmore, Pa.  
Eureka & Palisade R. R. 3 g. 84 m. 5 lo. 125 cars.  
D. J. Colton, Gen. Supt. & Pur. Agt. Palisade, Nev.  
E. W. Harris, M. M. Palisade, Nev.  
Eureka Springs Ry. 4-8 1/2 g. 18 1/2 m. 2 lo. 8 cars.  
Powell Clayton, Gen. Man. Eureka Springs, Ark.  
C. H. Smith, Pur. Agt. St. Louis, Mo.  
J. B. Obenshain, M. M. Eureka Springs, Ark.  
Evansv. & Terre Haute and Evansville & Indianapo-  
lis Rys. 4-8 1/2 g. 317 m. 65 lo. 4,268 c.  
H. C. Barlow, P. & G. Man. Evansville, Ind.  
A. L. Sanger, P. A. Evansville, Ind.  
John Torrence, S. M. P. & E. S. Evansville, Ind.  
F  
Fall Brook Ry. 4-8 1/2 g. 257 m. 84 lo. 3,000 c.  
Fall Brook, Syracuse, Geneva & Corning; Pine  
Creek; Geneva & Lyons.  
G. B. Brown, Gen. Supt. Corning, N. Y.  
W. H. Chappe, Pur. Agt. Corning, N. Y.  
Wm. A. Foster, Supt. Mach. Corning, N. Y.  
C. J. Butler, M. C. B. Corning, N. Y.  
Farmville & Powhatan R. R. 3 g. 93 m. 5 lo. 148 c.  
Jas. R. Werth, Gen. Man. Richmond, Va.  
W. B. Strother, Pur. Agt. Chester, Va.  
O. K. Bowles, M. M. & M. C. B. Chester, Va.  
Findlay, Fort Wayne & Western Ry.  
4-8 1/2 g. 80 m. 5 lo. 84 cars.  
C. M. Bissell, Gen. Man. & Pur. Agt.,  
Fort Wayne, Ind.  
A. W. Stalder, M. M. Findlay, Ohio.  
Fitchburg R. R. 4-8 1/2 g. 457.78 m. 204 lo. 6,169 c.  
W. D. Ewing, Gen. Supt. Boston, Mass.  
Ger. J. Fisher, Pur. Agt. Boston, Mass.  
J. Medway, Supt. M. P. Boston, Mass.  
J. W. Marden, Supt. Car Dept. Boston, Mass.  
B. W. Simonds, M. M. Boston, Mass.  
Flint & Pere Marq.  
3 & 4-8 1/2 g. 753 m. 103 lo. 3,563 cars.  
S. T. Crapo, G. M. Saginaw, E. S. Mich.  
H. D. Norris, Pur. Agt. Saginaw, E. S. Mich.  
T. J. Hatawell, M. M. & M. C. B. Saginaw, E. S. Mich.  
Florida Midland Ry. 4-8 1/2 g. 45 m. 2 lo. 6 cars.  
H. S. Chubb, Rec. Klammeec, Fla.  
J. M. Booth, Supt. & P. A. Klammeec, Fla.  
Florida Central & Peninsular R. R.  
4-9 g. 940.77 m. 73 lo. 2,045 cars.

## Railway Car Construction

200 PAGES. 500 ENGRAVINGS.

By WILLIAM VOSS.

With Full Working Drawings of Every  
Style of Car Now Used on American  
Railroads.

Address . . . . .

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL,

Morse Building, New York.



The PRENTISS CLOCK IMPROVEMENT CO.  
Synchronizers and Time Plants.  
49 DEY STREET, NEW YORK CITY.

### BELL'S IMPROVED STEAM HAMMER.

45 in Use  
in Buffalo  
Alone.



#### 4 Different Sizes.

	Diam.	Stroke	Cylin- or	der.	Lift.
No. 1	6 in.	16 in.			
No. 2	8 in.	18 in.			
No. 3	10 in.	22 in.			
No. 4	12 in.	27 in.			

	Strikes Blow
No. 1	- 2,000 lbs.
No. 2	- 4,000 lbs.
No. 3	- 6,000 lbs.
No. 4	- 10,000 lbs.

Illustrated Catalogue and Prices  
sent on applica-  
tion.

BELL'S ENGINE WORKS, Buffalo, N. Y.  
ESTABLISHED 1845. —◆—

**EWALD IRON COMPANY,**  
—OWNERS AND OPERATORS—  
**TENNESSEE ROLLING WORKS, TENNESSEE ROLLING MILLS,**  
CUMBERLAND RIVER. LOUISVILLE, KY.  
—MANUFACTURERS OF—  
**TENNESSEE BLOOM STAYBOLT IRON.**  
Office and Warehouses: ST. LOUIS, MO.

## "THE WELLS LIGHT"

WALLWORK & WELLS' PATENTS. (Registered Title.)



"ALWAYS  
READY."

800 to 4,000 Candle Power from Oil.

ESPECIALLY ADAPTED FOR  
WRECKING CARS, NIGHT CONSTRUCTION and  
HEAVY METAL HEATING,

FOR WHICH PURPOSES ITS  
Portability, Power and Automatic  
Action make it Invaluable.

400 Railroads and Over 300  
Contractors Now Use  
The "WELLS LIGHT"

Being Perfectly Safe and Unaffected by Weather.

Request Circular from

**THE WELLS LIGHT MFG. CO.,**  
EDWARD ROBINSON, Sole Prop.,  
43 Washington St., New York.

BE SURE THAT YOUR TICKETS READ VIA  
**FITCHBURG RAILROAD.**  
"TAKE NO OTHER."

**HOOSAC TUNNEL ROUTE.**  
SHORTEST LINE OF ALL BETWEEN THE EAST AND WEST.  
Passing through the Most Beautiful and Picturesque Scenery in New England, and the only line  
running  
**PULLMAN PALACE BUFFET SLEEPING CARS.**  
FROM BOSTON TO CHICAGO WITHOUT CHANGE.

Also the only line running **ELEGANT PALACE SLEEPING CARS** from Boston to Chicago  
via Niagara Falls, without change. For rates of fare, maps, time tables, etc., consult the authorized  
ticket agent in your own city or town. J. R. WATSON, General Passenger Agent, Boston, Mass.

**THE FINISHED STEEL CO**  
YOUNGSTOWN, OHIO  
MFR'S OF **POLISHED SHAFTING**

D. E. Maxwell, G. M. & Pur. A. Jacksonville, Fla.  
 E. Burton, M. M. .... Fernandez, Fla.  
 J. J. Bassenger, M. C. B. .... Fernandez, Fla.  
 Florida East Coast Ry. 4-8½ g. 401 m. 27 lo. 157 c.  
 J. D. Wright, Pur. Agt. .... New York, N. Y.  
 Geo. A. Miller, M. M. .... St. Augustine, Fla.  
 P. F. Starr, M. C. B. .... St. Augustine, Fla.  
 Florida Southern Ry. (See Plant System).  
 Fonda, Johnst'n & Gloversv. 4-8½ g. 32 m. 9 lo. 49 c.  
 R. T. McKee, G. S. & Pur. Agt. Gloversville, N. Y.  
 F. E. Driscoll, M. M. & M. C. B. Gloversville, N. Y.  
 Ft. Worth & Denver City Ry.  
 4-8½ g. 469 m. 32 l. 1,018 cars.  
 Morgan Jones, Receiver. .... Fort Worth, Tex.  
 J. V. Goode, G. S. & Pur. Agt. Ft. Worth, Tex.  
 E. W. Hayes, Supt. M. P. .... Fort Worth, Tex.  
 Fort Worth & Rio Grande Ry. 4-8½ g. 147 m. 9 l. 109 c.  
 John Hornby, Pres. G. S. & P. A. Fort Worth, Tex.  
 H. D. Galbraith, M. M. & M. C. B. Ft. Worth, Tex.  
 Franklin & Megantic R. R. 2 g. 25 m. 2 lo. 45 c.  
 V. B. Mead, Pres. & Gen. Man. .... Boston, Mass.  
 P. H. Stubbs, Pur. Agt. .... Strong, Mass.  
 W. S. Heath, M. M. & M. C. B. .... Salem, Me.  
 Fremont, Elkhorn & Mo. Val. R. R. (See Stouze C. & Pac.)  
 Fulton County N. G. Ry. 2 g. 61 m. 5 lo. 190 cars.  
 S. H. Mallory, Gen. Man. .... Charleston, Ia.  
 A. C. Atherton, Gen. S. & P. Agt. Lewistown, Ill.

## G

Gal., Harrisburg & San Antonio Ry. (See So. Pac.  
 Galveston, La. Port & Houston Ry.  
 4-8½ g. 56 m. 4 l. 188 c.  
 J. Waldo, Pres. & Gen. Man. .... Houston, Tex.  
 T. W. House, M. T. Jones, Receivers,  
 Houston, Tex.  
 S. R. Tuggle, Supt. M. P. & M. Houston, Tex.  
 George's Creek & Cumberland R. R.  
 4-9 g. 33 m. 10 lo. 1,108 cars.  
 J. A. Millholland, Pres., G. M. & P. A.  
 Cumberland, Md.  
 Thos. McCann, M. M. & M. C. B. Cumberland, Md.  
 Georgia R. R. 4-9 g. 303 m. 51 lo. 1,043 cars.  
 Thos. K. Scott, G. M. & P. A. .... Augusta, Ga.  
 John S. Cook, M. M. .... Augusta, Ga.  
 E. S. Scheetz, M. C. B. .... Augusta, Ga.  
 Georgia & Alabama Ry.  
 4-8½ g. 265 m. 25 lo. 1,310 cars.  
 Cecil Gabbett, F. P. G. M. & P. Agt.  
 Americus, Ga.  
 J. E. Worswick, M. M. & M. C. B.  
 Americus, Ga.  
 Georgia, Midland Ry. (See Southern Ry.)  
 Georgia Southern & Florida Ry. Co.  
 4-8½ g. 285 m. 29 lo. 987 cars.  
 J. Lane, Gen. Supt. & Pur. Agt. .... Macon, Ga.  
 J. E. Capps, M. C. B. .... Macon, Ga.  
 Gettysburg & Harrisburg R. R. (See Phila. & Read-  
 ing R. R.)  
 Grafton & Upton R. R. 4-8½ g. 16½ m. 3 lo. 6 c.  
 E. P. Usher, Gen. M. & P. A. .... Grafton, Mass.  
 Grand Rapids & Indiana. 4-9 g. 581 m. 73 lo. 3,229 c.  
 J. H. P. Hugbart, G. M. .... Grand Rapids, Mich.  
 W. R. Shelby, F. P. & P. A. Grand Rapids, Mich.  
 J. E. Keegan, M. M. .... Grand Rapids, Mich.  
 Grand Tower & Carbonade. (See Chicago & Tex.)  
 Grand Trunk Ry. 4-8½ g. 3,512 m. 795 lo. 23,486 c.  
 Chas. M. Hays, Gen. Man. .... Montreal, Can.  
 Adolph Butze, Gen. Pur. Agt. .... Montreal, Can.  
 F. W. Morse, Supt. M. P. .... Montreal, Can.  
 H. Roberts, Mech. Supt. .... Detroit, Mich.  
 Wm. McWood, Supt. Car Dept. .... Montreal, Can.  
 F. L. Wanklyn, A. M. S. Lo. Works. .... Montreal, Can.  
 J. D. Barnett, A. M. S. Lo. Works. .... Stratford, Ont.  
 J. W. Harkom, A. M. S. C. Div. .... Toronto, Ont.  
 A. H. Smith, A. M. S. W. Dir. .... London, Ont.  
 Great Northern Ry. line:  
 Great Northern Ry. Co.; Montana Central Ry.  
 Co.; Willmar & Sioux Falls Ry. Co.; Duluth,  
 Watertown & Pac. Ry. Co.; P. cific Coast lines.  
 Eastern Ry. of Minn.  
 4-8½ g. 4,488 m. 435 lo. 14,819 cars.  
 Jas. M. Barr, Gen. Supt. .... St. Paul, Minn.  
 Howard James, Pur. Agt. .... Duluth, Minn.  
 J. O. Pattee, Supt. M. P. .... St. Paul, Minn.  
 Green Bay & Western R. R.  
 4-8½ g. 250 m. 22 lo. 494 cars.  
 S. W. Champion, G. M. & P. A. Green Bay, Wis.  
 A. Fenwick, M. M. .... Green Bay, Wis.  
 Greenfield & Northern, R. R.  
 (See Kansas City, Fort Scott & Memphis R. R.)  
 Green Pond, Waterboro & Branchville Ry.  
 4-9 g. 14 m. 1 lo. 2 cars.  
 C. S. Gadsden, Supt. .... Charleston, S. C.  
 W. F. Loughman, Pur. Agt. New York, N. Y.  
 Wm. Rutherford, Supt. M. P. & E. Savannah, Ga.  
 G. M. D. Riley, M. M. .... Savannah, Ga.  
 Green Ridge R. R. of Maryland.  
 3 g. 20 m. 2 lo. 22 cars.  
 F. Mertens, Pres. & P. A. Cumberland, Md.  
 Greenwiche & Johnsonville Ry. 4-8½ g. 15 m. 2 l. 5 c.  
 J. H. Thompson, G. M. & S. & P. Agt. .... N. Y.  
 Gulf, Beaumont & Kansas City Ry. Co.  
 4-8½ g. 64 m. 5 l. 207 c.  
 John H. Kirby, F. P. & Gen. Man.,  
 Houston, Tex.  
 W. C. Averill, Pur. Agt. .... Beaumont, Tex.  
 Harry J. White, M. M. & M. C. B.,  
 Beaumont, Tex.  
 Gulf & Chicago R. R. 3 g. 62½ m. 5 lo. 50 c.  
 C. L. Harris, Gen. Man. G. S. & P. A. Ripley, Miss.  
 Jno. Reed, M. M. & M. C. B. .... Ripley, Miss.  
 Gulf, Col. & Santa Fe Ry. (See A. T. & S. F. Ry.)  
 Gulf, W'n Texas & Pac. Ry. (See Southern Pacific.)

## H

Hannibal & St. Jo. R. R. 4-8½ g. 295 m. 66 lo. 1,828 c.  
 (See C. B. & Q. R. R.)  
 Houston & Texas R. R. (See N. Y. N. H. & H. R. R.)  
 Houston & Texas, Cen. Ry. 4-8½ g. 510 m. 113 lo. 2,579 c.  
 G. A. Quinlan, F. P. & Gen. Man. Houston, Tex.  
 Geo. H. Hines, Pur. Agt. .... New York, N. Y.  
 S. R. Tuggle, Supt. M. P. & M. Houston, Tex.  
 C. H. Burns, M. M. .... Houston, Tex.  
 James McGee, M. C. B. .... Houston, Tex.

Houston, E. & W. Tex. Ry.  
 4-8½ g. 192 m. 18 lo. 496 cars.  
 M. G. Howe, F. P. & Gen. Man. Houston, Tex.  
 A. S. Grant, M. M. & M. C. B. .... Houston, Tex.  
 N. S. Meldrum, Pur. Agt. .... Houston, Tex.  
 Humeston & Shenandoah R. R.  
 4-8½ g. 118 m. 18 lo. 80 cars.  
 E. C. Murphy, G. M., Rec. & P. Agt.,  
 Clarinda, Ia.  
 G. Knapp, M. M. & C. B. .... Shenandoah, Ia.  
 Huntingdon & Br. Top Mt. R. R.  
 4-9 g. 63 m. 24 lo. 2,692 c.  
 Geo. F. Gage, Gen. Man. .... Huntingdon, Pa.  
 Wm. W. Noble, Pur. Agt. .... Philadelphia, Pa.  
 C. R. Yohn, M. M. .... Saxton, Pa.  
 Hutchinson & Southern Ry. 4-8½ g. 83 m. 8 l. 28 c.  
 L. E. Walker, Rec. .... Hutchinson, Kan.  
 C. B. Hart, G. M., S. P. Agt., M. M. & M. C. B.  
 Hutchinson, Kan.

## I

Illinois Central R. R. 4-8½ g. 3,146.82 m. 650 lo. 21,670 c.  
 A. W. Sullivan, Gen. Supt. .... Chicago, Ill.  
 C. A. Beck, Pur. Agt. .... Chicago, Ill.  
 Wm. Renshaw, Supt. of Mach. .... Chicago, Ill.  
 F. W. Brazier, Asst. Supt. Mach. .... Chicago, Ill.  
 (1) Northern Lines:  
 J. C. Hartigan, Asst. G. Supt. .... Chicago, Ill.  
 Chic. Div.: H. Baker, Supt. .... Chicago, Ill.  
 J. W. Luttrell, M. M. .... Burnside, Ill.  
 St. Louis Div.:  
 H. McCourt, Supt. .... Centralia, Ill.  
 Amboy Div.: J. W. Higgins, Supt. La Salle, Ill.  
 J. S. Chambers, M. M. .... Clinton, Ill.  
 Springfield Div.:  
 D. S. Bailey, Supt. .... Clinton, Ill.  
 J. S. Chambers, M. M. .... Clinton, Ill.  
 J. W. Stokes, M. M. .... East St. Louis, Ill.  
 Freeport Div.:  
 H. R. Dill, Supt. .... Freeport, Ill.  
 E. O. Dana, M. M. .... Freeport, Ill.  
 Dubuque Div.:  
 F. B. Harriman, Supt. .... Dubuque, Ia.  
 T. W. Place, M. M. .... Waterloo, Ia.  
 Cherokee Div.: C. K. Dixon, Supt. .... Cherokee, Ia.  
 T. W. Place, M. M. .... Waterloo, Ia.  
 So. Lines:  
 (2) M. Gillespie, Asst. G. S. Southern Lines.

Memphis, Tenn.  
 Miss. Div.: W. S. King, Supt. .... Jackson, Tenn.  
 Wm. Hassman, M. M. .... Water Valley, Miss.  
 La. Div.: O. M. Dunn, Supt. .... New Orleans, La.  
 F. C. Lasey, M. M. .... McComb City, Miss.  
 Memphis Div.: J. B. Kemp, Supt. Memphis, Tenn.  
 J. J. O'Rourke, M. M. .... Memphis, Tenn.  
 Indiana & Illinois Southern R. R. 4-9 g. 91 m. 6 l. 10 c.  
 P. H. Blue, Gen. Man. & P. Agt. Sullivan, Ind.  
 M. E. Hotchkiss, M. M. .... Palestine, Ill.  
 Indiana, Illinois & Iowa R. R.  
 4-8½ g. 151.82 m. 25 l. 239 c.  
 T. P. Shonts, Gen. Man. & Pur. Agt. Chicago, Ill.  
 Peter Maher, M. M. & M. C. B. Kankakee, Ill.  
 Indianapolis & St. Louis R. R. (See C. C. & St. L.)  
 Indianapolis & Vincennes R. R. (See Penn. Co.)  
 Indiana, Decatur & Western Ry.  
 4-8½ g. 153 m. 18 lo. 762 c.  
 R. B. F. Pierce, Gen. Man. .... Indianapolis, Ind.  
 George R. Balch, Pur. Agt. .... Cincinnati, O.  
 J. W. Connaty, Act. M. M. .... Indianapolis, Ind.  
 Intercolonial Ry. of Canada.  
 4-8½ g. 1,142 m. 204 lo. 6,842 c.  
 David Pottinger, Gen. Man. .... Moncton, N. B.  
 T. V. Cooke, Pur. Agt. .... Moncton, N. B.  
 F. R. F. Brown, Mech. Supt. .... Moncton, N. B.  
 Grant Hall, Gen. Loco. Fore. .... Moncton, N. B.  
 D. White, Gen. Car Foreman. .... Moncton, N. B.  
 International & Great Northern Ry.  
 4-8½ g. 825 m. 99 lo. 1,853 cars.  
 T. M. Campbell, Gen. Man. .... Palestine, Tex.  
 F. Hufsmith, M. M. .... Palestine, Tex.  
 W. E. Williams, Pur. Agt. .... Palestine, Tex.  
 Interoceanic Ry. 3 g. 519 m. 64 lo. 964 car.  
 G. M. Stewart, G. M. .... City of Mexico, Mex.  
 C. A. Crail, Pur. Agt. .... Texcoco, Mex.  
 E. V. Sedgwick, Supt. M. P. & M.,  
 City of Mexico, Mex.  
 E. M. Ruth, M. C. B. .... Texcoco, Mex.  
 Iowa Central Ry. 4-8½ g. 498 m. 66 lo. 2,255 cars.  
 Col. L. M. Martin, G. M. .... Marshalltown, Ia.  
 S. M. Rogers, Pur. Agt. .... Marshalltown, Ia.  
 B. Kelley, M. M. .... Marshalltown, Ia.  
 E. E. Carver, M. C. B. .... Marshalltown, Ia.  
 Iron Ry. 4-8½ g. 20 m. 4 lo. 214 cars.  
 C. C. Clarke, Gen. Man. .... Ironton, O.  
 B. S. J. Garvey, Pur. Agt. .... Ironton, O.  
 G. A. Meyers, M. M. .... Ironton, O.  
 B. Martin, M. C. B. .... Ironton, O.  
 Irondale, Bancroft & Ottawa Ry.  
 4-8½ g. 45 m. 2 lo. 38 cars.  
 Chas. J. Pusey, Gen. Man. & Pur. Agt.,  
 Irondale, Ont.  
 Jos. Webb, M. M. .... Irondale, Ont.  
 Ironton R. R. 4-8½ g. 12 m. 2 lo.  
 W. Andrews, Gen. Supt. .... Allentown, Pa.  
 D. W. McFetridge, Pur. Agt.,  
 Hokendauqua, Pa.  
 S. R. Thomas, M. M. .... Hokendauqua, Pa.

## J

Jacksonville & St. Louis Ry.  
 4-8½ g. 133 m. 8 lo. 185 cars.  
 Sam'l P. Wheeler, Rec. .... Jacksonville, Ill.  
 C. M. Stanton, Gen. Man. .... Jacksonville, Ill.  
 Edwin M. Stanton, P. Agt. .... Jacksonville, Ill.  
 John Foulk, M. M. & M. C. B. Jacksonville, Ill.  
 Jacksonville, Tampa & Key West Ry.  
 4-9 g. 200 m. 26 lo. 528 cars.  
 Joseph H. Durkee, Receiver. Jacksonville, Fla.  
 W. B. Coffin, G. S. & P. A. Jacksonville, Fla.  
 F. E. Tubbs, M. M. .... Palatka, Fla.  
 Jamestown & Lake Erie Ry. Co.  
 4-8½ g. 26 m. 4 l. 14 cars.  
 E. T. Haines, G. M. & P. A. Jamestown, N. Y.  
 W. J. Davis, M. M. & M. C. B.,  
 Jamestown, N. Y.  
 Jeffersonv., Mad. & Ind. R. R. (P. C. C. & St. L. Ry.)

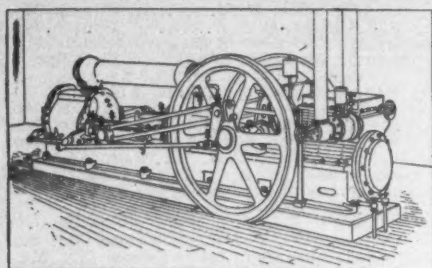
## K

Kanawha & Michigan Ry. 4-9 g. 168 m. 15 l. 600 c. (See Ohio Central lines.)  
 Kansas City, St. Joseph & Council Bluffs.  
 4-8½ g. 308 m. 44 lo. 1,038 c.  
 (See C. B. & Q. R. R.)  
 Kansas City, Osceola & Southern Ry. (Blair Line.)  
 4-8½ g. 113 m. 11 lo. 314 c.  
 B. S. Josselyn, G. M. & P. A. .... Clinton, Mo.  
 C. A. Burdick, M. M. .... Clinton, Mo.  
 S. F. Gentry, M. C. B. .... Clinton, Mo.  
 Kansas City, Fort Scott & Memphis, Kansas City.  
 Clinton & Springfield and Current River Rys.  
 4-8½ g. 515 m. 186 l. 7,625 c.  
 Edward S. Washburn, Pres. & G. M.,  
 Kansas City, Mo.  
 H. P. Jacques, Pur. Agt. .... Kansas City, Mo.  
 W. A. Nettleton, S. M. P. & M., Kansas City, Mo.  
 A. N. Monteer, M. C. B. .... Springfield, Mo.  
 Jas. Bissett, M. M. .... Springfield, Mo.  
 Kansas City Memphis & Birmingham R. R.  
 4-8½ g. 276 m. 41 lo. 1,798 c.  
 Edward S. Washburn, Pres. & Gen. Man.,  
 Kansas City, Mo.  
 H. P. Jacques, Pur. Agt. .... Kansas City, Mo.  
 W. A. Nettleton, Supt. M. P. & M.,  
 Kansas City, Mo.  
 R. H. Briggs, M. M. .... Memphis, Tenn.  
 Kansas City, Pittsburgh & Gulf R. R.  
 4 ft. 8½ in. g. 328 m. 35 lo. 1,337 cars.  
 E. L. Martin, Gen. Man. .... Kansas City, Mo.  
 Ira C. Hubbell, Pur. Agt. .... Kansas City, Mo.  
 W. Dawson, M. M. & M. C. B. Pittsburgh, Kan.  
 Kansas City, Watkins & Gulf Ry.  
 4-8½ g. 100 m. 7 lo. 186 cars.  
 Thos. Saunders, Gen. Man. Lake Charles, Ia.  
 J. B. Watkins, Pur. Agt. Lake Charles, Ia.  
 J. C. Ramsey, M. M. & M. C. B. Lake Charles, Ia.  
 Kent Northern Ry. 4-8½ g. 45 m. 4 lo. 31 cars.  
 W. Brown, Gen. Man. .... Richibucto, N. B.  
 T. Murray, Supt. & M. C. B. Richibucto, N. B.  
 Animaux, M. M. .... Richibucto, N. B.  
 Kentucky & Indiana Bridge Co.  
 4-8½ g. 15 m. 5 lo. 14 cars.  
 John MacLeod, Rec. .... Louisville, Ky.  
 F. W. Tracy, Rec. .... Springfield, Ill.  
 S. M. Felton, Rec. .... Cincinnati, O.  
 K. MacLeod, Pur. Agt. .... Louisville, Ky.  
 J. Newhouse, M. M. .... Louisville, Ky.  
 L. Fogleman, M. C. B. .... Louisville, Ky.  
 Kentucky Midland Ry. 4-8½ g. 40 m. 4 l. 36 c.  
 Geo. B. Harper, Rec. & P. A. Frankfort, Ky.  
 M. Horton, M. M. .... Frankfort, Ky.  
 John Quinley, M. C. B. .... Frankfort, Ky.  
 Kentucky & South Atlantic Ry. (See Chesapeake  
 & Ohio Ry. Co.)  
 Kentucky Central Ry. (Operated by L. & N. R. R.)  
 Keokuk & Western R. R. 4-8½ g. 148 m. 14 l. 955 c.  
 A. C. Goodrich, G. M. .... Keokuk, Ia.  
 R. D. Lewis, Pur. Agt. .... Keokuk, Ia.  
 W. Augustus, Supt. Mach. .... Keokuk, Ia.  
 Kickapoo Valley & Northern Ry. Co.  
 4-8½ g. 34 m. 2 lo. 21 cars.  
 W. H. Thomson, G. M. & P. A. M. M. & M. C. B.,  
 Waukegan, Wis.  
 Kings Co. Elevated Ry. 4-8½ g. 8½ m. 44 lo. 145 c.  
 W. T. Goundie, Gen. Man., Supt. & Pur. Agt.,  
 Brooklyn, N. Y.  
 W. F. Thompson, M. M. .... Brooklyn, N. Y.  
 W. S. Sutton, M. C. B. .... Brooklyn, N. Y.  
 Kingston & Pembroke Ry. 4-8½ g. 113 m. 9 lo. 240 c.  
 Jos. Bawden, Receiver. .... Kingston, Ont.  
 B. W. Folger, Gen. Man. .... Kingston, Ont.  
 J. Whitbread, Pur. Agt. .... Kingston, Ont.  
 F. Clark, M. M. .... Kingston, Ont.  
 D. Nesbith, M. C. B. .... Kingston, Ont.  
 Knoxville & Augusta R. R. 4-8½ g. 16 m. 2 lo. 30 cars.  
 W. P. Hood, Gen. Supt. & P. A. Knoxville, Tenn.  
 John L. Bradford, M. M. .... Knoxville, Tenn.  
 W. C. Bruce, M. C. B. .... Knoxville, Tenn.  
 Knoxville, Cumberland Gap & Louisville R. R.  
 4-9 g. 81.80 m. 12 lo. 450 cars.  
 W. H. Green, Gen. Supt. Washington, D. C.  
 W. H. Thomas, Supt. M. P. Washington, D. C.  
 H. Clark, M. C. B. .... Knoxville, Tenn.

## L

Lake Champlain & Moriah Ry.  
 4-8½ g. 16 m. 9 lo. 336 cars.  
 A. E. Tower, G. M. & P. A. Poughkeepsie, N. Y.  
 C. P. Morrison, M. M. .... Port Henry, N. Y.  
 C. S. Smith, M. C. B. .... Port Henry, N. Y.  
 Lake Erie, Alliance & So'n Ry. 4-8½ g. 36 m. 3 l. 74 c.  
 E. E. Scranton, Rec. M. & P. Agt. .... Alliance, O.  
 C. P. Finch, M. C. Repairer. .... Alliance, O.  
 Lake Erie & Detroit River Ry.  
 4-8½ g. 108 m. 8 lo. 218 c.  
 E. C. Walker, Gen. Dir. .... Walkerville, Ont.  
 Alex. Leale, Pur. Agt. .... Walkerville, Ont.  
 S. Austin, Mech. Supt. .... Walkerville, Ont.  
 Lake Erie & West'n R. R. and Ft. Wayne, Cin. &  
 Louisville Ry. 4-8½ g. 725 m. 119 lo. 5,419 c.  
 Geo. L. Bradbury, F. P. & G. M. Indianapolis, Ind.  
 T. H. Perry, Pur. Agt. .... Indianapolis, Ind.  
 F. Reilly, Supt. Equipment .... Lima, O.  
 Lake Shore & Michigan So'n Ry.  
 4-8½ g. 1,448 m. 576 lo. 19,872 cars.  
 D. W. Caldwell, Pres. .... Cleveland, O.  
 W. H. Canniff, Gen. Man. .... Cleveland, O.  
 Chas. B. Couch, Pur. Agt. .... Cleveland, O.  
 G. W. Stevens, Supt. M. P. .... Cleveland, O.  
 A. M. Waitt, Gen. M. C. B. .... Cleveland, O.  
 A. A. Bradeen, M. M. .... Cleveland, O.  
 East'n Div.: T. W. Niles, Supt. .... Buffalo, N. Y.  
 E. E. Elden, M. M. .... Buffalo, N. Y.  
 A. C. Robson, M. C. B. .... Buffalo, N. Y.  
 Geo. N. Dow, M. C. B. .... Cleveland, O.  
 Frank. Div.: A. H. Smith, Supt. Youngstown, O.  
 Toledo Div.: J. K. Russell, Supt. .... Cleveland, O.  
 J. O. Bradeen, M. M. .... Norwalk, O.  
 J. R. Benitt, M. C. B. .... Norwalk, O.  
 Mich. Div.: L. E. Johnson, Supt. .... Toledo, O.  
 F. O. Bray, M. C. B. .... Adrian, Mich.  
 Det. Div.: H. A. Worcester, Supt. Detroit, Mich.

# THE NORWALK AIR COMPRESSOR



— OF STANDARD PATTERN

is built with Tandem Compound Air Cylinders. Corliss Air Valves on intake cylinders insure small clearance spaces. The intercooler between the cylinders saves power by removing the heat of compression before the work is done, not after, and the compressing is all done by a straight pull and push on a continuous piston rod. The Compressor is self-contained; the repair bills are reduced to a minimum, and the machine is economical and efficient. Special machines for high pressures and for liquefying gases.

A Catalogue, explaining many points of superiority, is sent free to business men and Engineers who apply to . . . . .

**THE NORWALK IRON WORKS CO.,** South Norwalk, Conn.

## — RAILWAY CAR CONSTRUCTION.

200 Pages.

500 Engravings.

By WILLIAM VOSS.

*With Full Working Drawings of Every Style of Car  
Now Used on American Railroads. . . . .*

— ADDRESS

**AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL,**

**MORSE BUILDING, NEW YORK.**

Lansing, Ypsilanti & Ft. Wayne Branches:  
M. L. Reynolds, Supt. Hillsdale, Mich.  
Western Div.: A. B. Newell, Supt., Chicago, Ill.  
W. L. Gilmore, M. C. B., Elkhart, Ind.  
T. Fildes, M. C. B., Englewood, Ill.  
Lakeside & Marblehead R.R. Co. 4-84g 10m. 21.11c.  
C. E. Gowen, G. M. & P. A., Cleveland, O.  
W. M. Harsh, G. S., Cleveland, O.  
Lancaster, Oxford & Southern R.R. 3g. 20m. 21.23c.  
A. M. Nevin, Gen. Man. & P. A., Oxford, Pa.  
Lebanon Springs R. R. 4-84g 58 m. 4 lo. 18 cars.  
Wm. V. Reynolds, Rec., Bennington, Vt.  
K. D. Bennett, Supt. & Pur. Agt., Bennington, Vt.  
Lehigh & Hudson River Ry. 4-84g 87m. 22lo. 75c.  
Grinnell Burt, Gen. Man., Warwick, N. Y.  
E. M. Reynolds, Pur. Agt., Warwick, N. Y.  
F. M. Mast, M. C. B., Warwick, N. Y.  
Lehigh & Lackawanna R.R. (See Cent. R.R. of N. J.)  
Lehigh Valley R. R. 4-84g 1,177m. 733 lo. 56,284c.  
R. H. Wilbur, Gen. Supt., So. Bethlehem, Pa.  
Samuel Higgins, Supt. M. P. & S. Bethlehem, Pa.  
W. C. Alderson, Pur. Agt., Philadelphia, Pa.  
J. I. Kinsey, M. C. B., So. Easton, Pa.  
Phillip Wallis, M. C. B., Hazleton, Pa.  
F. Roth, M. C. B., Wilkes-Barre, Pa.  
J. N. Weaver, M. C. B., Sayre, Pa.  
John Campbell, M. C. B., Buffalo, N. Y.  
J. F. Richards, Asst. M. C. B., Cortland, N. Y.  
H. D. Taylor, Mech. Eng., So. Easton, Pa.  
John S. Lentz, Supt. Car Dept. Packerton, Pa.  
Lexington & Eastern Ry. Co.  
4-9 g. 94 m. 8 lo. 373 cars.  
J. D. Livingston, G. M. & P. A., Lexington, Ky.  
Geo. F. Foster, M. C. B., Lexington, Ky.  
Ligonier Valley R. R. 4-9 g. 11 m. 3 lo. 19 cars.  
Thos. A. Mellon, Gen. Man., Ligonier, Pa.  
Geo. Sentz, S. P. A. & M. C. B., Ligonier, Pa.  
Sam'l L. French, M. C. B., Ligonier, Pa.  
Little Miami Ry. (See P. C. & S. L.)  
Little Rock & Fort Smith. (See Mo. Pac.)  
Lit. Rock & Memphis R.R. 4-84g 135m. 16lo. 350c.  
R. Fink, G. M. & P. A., Little Rock, Ark.  
C. Robbin, M. C. B., Argenta, Ark.  
C. Waldo, M. C. B., Argenta, Ark.  
Little Saw Mill Run R. R. 4-84g 3 m. 4 lo. 178c.  
R. W. Jones, Gen. Man., Pittsburgh, Pa.  
C. Schoeneman, Pur. Agt., Pittsburgh, Pa.  
J. Richards, M. C. B., Banksville, Pa.  
Jas. Easton, M. C. B., Banksville, Pa.  
Litchfield, Carrollton & Western Ry. Co.  
4-84g 58 m. 21. 36 cars.  
Jos. Dickson, Receiver, St. Louis, Mo.  
C. B. McCall, G. M. S. & P. A., Carlinville, Ill.  
W. E. Roberts, M. C. B. & M. C. B., Carrollton, Ill.  
Live Oak & Gulf Ry. 4-9 g. 21 m. 1 lo., 3 cars.  
C. J. McGehee, Gen. Man., Live Oak, Fla.  
Chas. W. White, Pur. Agt., Citra, Fla.  
C. M. Ingala, M. C. B., Live Oak, Fla.  
Long Island R. R. 4-84g 367.45 m. 148 lo. 1,763 c.  
E. R. Reynolds, Gen. Man., Long Island City, N. Y.  
G. L. Hubbell, Pur. Agt., Long Island City, N. Y.  
S. F. Prince, Jr., S. M. P. & E. Morris Park, N. Y.  
Los Angeles Terminal Ry.  
4-84g 50 m. 8 lo. 170 cars.  
S. B. Hynes, G. M. & P. A., Los Angeles, Cal.  
T. R. Shanks, M. C. B. & M. C. B., Los Angeles, Cal.  
Louisville & Nashville R. R.  
4-9 g. 3,171 m. 540 lo. 20,104 cars.  
J. G. Metcalfe, Gen. Man., Louisville, Ky.  
P. P. Buxton, Pur. Agt., Louisville, Ky.  
P. Leeds, Supt. Mach., Louisville, Ky.  
A. Beckert, Gen. M. C. B., New Decatur, Ala.  
Kent. Cen. Div.: L. Hood, Supt., Cincinnati, O.  
Wm. Adair, M. C. B., Covington, Ky.  
Louisv. Cin. & Lex. Div.:  
C. A. Davies, Supt., E. Louisville, Ky.  
Wm. Adair, M. C. B., E. Louisville, Ky.  
Lou. Div.: W. S. Martin, Supt., Louisville, Ky.  
J. G. Clifford, M. C. B., Louisville, Ky.  
Nash. Div.: J. Geddes, Supt., Nashville, Tenn.  
R. Moran, M. C. B., Bowling Green, Ky.  
Alabama Mineral Div.:  
W. E. Knox, Supt., Anniston, Ala.  
J. H. Watters, M. C. B., Anniston, Ala.  
Mob. & M.: Div. Pens. & Sel. R. R.:  
J. I. McKinney, Supt., Montgomery, Ala.  
H. Minto, M. C. B., Mobile, Ala.  
Pensacola Div.:  
E. O. Saltmarsh, Supt., Pensacola, Fla.  
C. F. Giles, M. C. B., Pensacola, Fla.  
Memph. Div.: L. S. Robertson, S. Memphis, Tenn.  
J. V. Slusser, M. C. B., Memphis, Tenn.  
St. L. & Hend. Div.:  
B. F. Dickson, Supt., Evansville, Ind.  
Thos. Walsh, M. C. B., Howell, Ind.  
Louisville, Evansville & St. L. Consolidated R. R.  
5 ft. 9 in. g. 378.78 m. 59 lo. 2,448 cars.  
G. T. Jarvis, G. M. & Rec., Louisville, Ky.  
W. W. Wents, Jr., Pur. Agt., Louisville, Ky.  
F. C. Cleaver, M. C. B., Princeton, Ind.  
Jas. Gaston, M. C. B., Princeton, Ind.  
Louisville, New Albany & Corydon.  
4-84g 11 m. 21. 3 cars.  
M. J. O'Connor, Gen. Man., Corydon, Ind.  
G. W. Briffett, S. P. A. & M. C. B., Corydon, Ind.  
Louisville, New Albany & Chicago Ry.  
4-84g 537.44 m. 97 lo. 6,077 cars.  
W. H. McDoel, G. M. & Rec., Chicago, Ill.  
B. E. Taylor, Pur. Agt., Chicago, Ill.  
Henry Watkeys, M. C. B., New Albany, Ind.  
Chas. Collier, M. C. B., Lafayette, Ind.  
Louisville, New Orleans & Tex. Ry. (See Ill. Central)  
Louisville, Henderson & St. Louis Ry.  
4-9 g. 186 m. 18 lo. 768 cars.  
Attilla Cox, Rec., Louisville, Ky.  
A. M. McCracken, Gen. Supt., Louisville, Ky.  
C. P. Bush, Pur. Agt., Louisville, Ky.  
F. J. Ferry, M. C. B., Cloverport, Ky.

A. H. Porter, Supt., Macon, Ga.  
W. A. Carey, Fore. Car Dept., Macon, Ga.  
Macon, Dublin & Savannah.  
4-84g 54 m. 2 lo. 47 cars.  
J. T. Wright, Gen. Man., Macon, Ga.  
P. Hough, Pur. Agt., Macon, Ga.  
D. B. Dunn, G. S., M. M. & M. C. B., Macon, Ga.  
Maine Central R. R. 4-84g 821m. 157 lo. 4,217 c.  
Payson Tucker, V. Pres. & G. M., Portland, Me.  
A. S. Bosworth, Supply Agt., Portland, Me.  
Amos Pillsbury, Supt. M. P., Portland, Me.  
John Ellis, M. C. B., Waterville, Me.  
O. H. Kenison, M. C. B., Portland, Me.  
Manhattan Ry. 4-84g 38 m. 38 lo. 1,116 c.  
Wm. J. Franchot, Act. G. M., New York, N. Y.  
M. McNally, M. C. B., New York, N. Y.  
H. A. Webster, M. C. B., New York, N. Y.  
Manistee & Luther Ry. 3 g. 60 m. 6 lo. 240 cars.  
R. G. Peters, Gen. Man., Eastlake, Mich.  
H. W. Carey, Pur. Agt., Eastlake, Mich.  
T. J. Peach, M. M. & M. C. B., Eastlake, Mich.  
Manistee & North East'n Ry. 4-84g 90 m. 8 lo. 295c.  
Edward Buckley, Gen. Man., Manistee, Mich.  
J. M. Peterson, Pur. Agt., Manistee, Mich.  
Wm. H. Nuttall, S. M. P. & R. S., Manistee, Mich.  
E. N. Weist, M. C. B., Manistee, Mich.  
Maricopa, Phoenix & Salt River Valley R. R.  
4-84g 34.28 m. 31. 56 c.  
Edward Kamp, Gen. Supt., Phoenix, Ariz.  
F. I. Kennell, Pur. Agt., San Francisco, Cal.  
M. S. Webb, M. C. B., Phoenix, Ariz.  
T. J. Morrison, M. C. B., Phoenix, Ariz.  
Marietta & North Georgia R. R.  
4-9 g. and 3 ft. g. 231 m. 231 m. 18 lo. 250 c.  
J. B. Glover & E. C. Spalding, Receivers, Marietta, Ga.  
Jos. McWilliams, Supt., Marietta, Ga.  
J. B. Glover, Jr., S. M. P., Marietta, Ga.  
Mason & Oceana Ry. 3 g. 27 m. 7 lo. 225 cars.  
M. McDermott, Gen. Supt., Ludington, Mich.  
O. Wrege, M. C. B., Ludington, Mich.  
J. Johnson, M. C. B., Ludington, Mich.  
Mason City & Ft. Dodge R.R. 4-84g 92 m. 61. 207c.  
E. S. Hitchins, Supt., Fort Dodge, Ia.  
R. H. Emerson, M. M. & C. B., Fort Dodge, Ia.  
Massillon & Cleve. Ry. (See Penna. Co.)  
Meadville & Linesville Ry. (See Pitts. Shen. & Erie Ry.)  
Memphis & Charleston R. R. 4-9 g. 330m. 39 11,049c.  
R. B. Pegram, Gen. Supt., Memphis, Tenn.  
J. P. Minettes, Pur. Agt., Washington, D. C.  
J. H. Buckalew, M. C. B., Memphis, Tenn.  
R. T. Hayes, M. C. B., Memphis, Tenn.  
Mexican Ry. 4-84g 321 m. 65 lo. 770 cars.  
Geo. Foote, Gen. Man., Mexico, Mex.  
Alfred Atwood, Loco. Supt., Apizaco, Mex.  
Mexican Central Ry. Co., Limited.  
4-84g 1,880.36m. 161 lo. 3,053 cars.  
H. B. Nickerson, Gen. Man., City of Mexico.  
F. P. McIntyre, Pur. Agt., Boston, Mass.  
F. W. Johnston, Supt. M. P. & M. C. B., City of Mexico.  
J. H. O'Brien, M. C. B., City of Mexico.  
P. O. Address of all officers in Mexico is El Paso, Texas.)  
Mexican International R. R.  
4-84g 618 m. 46 lo. 1,488 cars.  
L. M. Johnson, Gen. Man., Ciudad Porfirio Diaz, Mex.  
W. Hollis, Mat. Agt., Ciudad Porfirio Diaz, Mex.  
W. Jennings, Supt. Mech. Dept., Ciudad Porfirio Diaz, Mex.  
Mexican National R. R. 3 g. 1,218 m. 122 lo. 2,538 c.  
E. N. Brown, Gen. Man., City of Mexico.  
A. Anderson, Jr., Pur. Agt., New York, N. Y.  
Thos. Milan, S. M. P. & Mach., Laredo, Tex.  
Northern Division:  
J. N. Galbraith, Supt., Laredo, Tex.  
J. Farrell, M. C. B., Laredo, Tex.  
San Luis Potosi Div.:  
A. Clarke, Supt., San Luis Potosi, Mex.  
J. H. Ebert, M. C. B., San Luis Potosi, Mex.  
Southern Div.:  
V. R. Dwinell, Supt., City of Mexico, Mex.  
E. W. Knapp, M. C. B., City of Mexico, Mex.  
Mexican Southern Ry. 3 g. 228 m. 17 lo. 312 c.  
W. Morcom, G. M. & P. A., Puebla, Mex.  
H. E. Walker, M. M. & M. C. B., Puebla, Mex.  
Michoacan & Pacific Ry.  
3 g. 60 m. 5 lo. 81 cars.  
L. R. Gordon, G. S. & P. A., Las Trojes, Ocampo, Michoacan, Mex.  
J. O. Nicholas, M. M. & M. C. B., Las Trojes, Ocampo, Michoacan, Mex.  
Michigan Cen. R. R. 4-84g 1,633m. 461 lo. 14,121c.  
H. B. Ledyard, Pres. & Gen. Man., Detroit, Mich.  
R. H. L'Hommedieu, Gen. Supt., Detroit, Mich.  
J. R. Dutton, Pur. Agt., Detroit, Mich.  
Robt. Miller, Supt. M. P. & E., Detroit, Mich.  
E. D. Bronner, Asst. Supt. M. P. & E., West Detroit, Mich.

(1) Lines West of Detroit River:  
East, Toledo & Bay City Divs.:  
D. S. Sutherland, Supt., Detroit, Mich.  
P. Miller, M. C. B., Detroit, Mich.  
Sag. & Mack Div.:  
W. J. Martin, Supt., Bay City, Mich.  
M. Ryan, M. C. B., Bay City, Mich.  
Mid. Air Line: Gr. Rap. and So. Hav. Divs.:  
O. F. Jordan, Supt., Jackson, Mich.  
West & Joliet Divs.:  
J. H. Snyder, Supt., Chicago, Ill.  
G. R. Riley, M. C. B., Chicago, Ill.  
(2) Lines East of Detroit River:  
Canada & Mich. Mid. Divs.:  
J. B. McFried, Supt., St. Thomas, Ont.  
M. L. Flynn, M. C. B., St. Thomas, Ont.  
B. Potts, Gen. F. C. Dept., St. Thomas, Ont.  
Middle Georgia & Atlantic Ry.  
4-84g 65 m. 4 lo. 8 cars.  
J. W. Preston, G. M. & Pur. Agt., Eatonton, Ga.  
Millen & Southern. 4-84g 32 m. 4 lo. 13 cars.  
J. F. Gray, Supt. & P. A., Millen, Ga.  
F. W. Reavey, M. C. B., Millen, Ga.

Mineral Range and Hancock & Calumet Rys.  
3 g. 54.21 m. 16 lo. 155 cars.  
W. F. Fitch, Gen. Man., Marquette, Mich.  
J. O. Shields, Supt., Hancock, Mich.  
P. W. Brown, P. A., Marquette, Mich.  
J. J. Conolly, M. M. C. B., Marquette, Mich.  
Midland No. Car Ry. (See Atl. Coast Line.)  
Milwaukee & Northern R.R. (See C. M. & St. P. Ry. Co.)  
Milwaukee, Lake Shore & Western Ry. Co. (See Chicago & Northwestern.)  
Minneapolis & St. Louis R. R. Co.  
4-84g 583 m. 73 lo. 2,617 cars.  
A. L. Mohler, Gen. Man., Minneapolis, Minn.  
T. E. Clarke, Gen. Supt., Minneapolis, Minn.  
S. M. Lohren, Pur. Agt., Minneapolis, Minn.  
J. Tongue, M. C. B. & M. M., Minneapolis, Minn.  
Minneapolis, St. Paul & Sault Ste. Marie.  
4-84g 1 160 m. 103 lo. 5,378 cars.  
F. D. Underwood, Gen. Man., Minneapolis, Minn.  
T. A. Switz, Pur. Agt., Minneapolis, Minn.  
E. A. Williams, Mech. Supt. Minneapolis, Minn.  
Mississippi River & Bonne Terre Ry.  
4-84g 74 m. 9 lo. 110 cars.  
J. Burns, Supt., Bonne Terre, Mo.  
G. Setz, P. A., Bonne Terre, Mo.  
J. F. Kehrmon, M. M. & M. C. B., Bonne Terre, Mo.  
Mississippi R. & No. West Ry. 4-84g 12m. 2 lo. 35c.  
A. Kimball, G. M. & Supt. Arkansas City, Ark.  
P. Kimball, P. A., Arkansas City, Ark.  
E. Kroger, M. C. B., Arkansas City, Ark.  
Missouri, Kansas & Texas Ry. Co.  
4-84g 2,198.2 m. 289 lo. 177 pass. c. 8,768 c.  
Thos. C. Purdy, V. P. & G. M., St. Louis, Mo.  
C. N. Stevens, Pur. Agt., St. Louis, Mo.  
Wm. O. Herrin, Supt. M. & E., Parsons, Kan.  
C. T. McElvany, M. C. B., Denison, Tex.  
W. H. Brehm, M. C. B., Parsons, Kan.  
J. Doyle, M. C. B., Denison, Tex.  
John L. Wigton, M. C. B., Sedalia, Mo.  
Missouri Pacific Ry. System, including Missouri Pac. Ry., St. Louis, Iron Mountain and Southern Ry. and leased, operated and independent lines.  
4-84g 5,326.05 m. 651 lo. 22,912 cars.  
Wm. B. Doddridge, Gen. Man., St. Louis, Mo.  
F. Rearden, Supt. Loco. & Car Depts., St. Louis, Mo.  
A. Gould, Pur. Agt., St. Louis, Mo.  
M. B. Schaffer, Gen. F. C. D., St. Louis, Mo.  
Missouri Pacific Ry. Co.  
4-84g 3,073.14 m. 351 lo. 967 pass. c. 12,475ft. c.  
H. G. Clark, Gen. Supt., St. Louis, Mo.  
L. Bartlett, Div. M. C. B., St. Louis, Mo.  
S. P. Weller, Asst. M. C. B., Sedalia, Mo.  
W. T. New, Asst. M. C. B., Kansas City, Kan.  
W. J. Hill, Asst. M. C. B., Oawatomie, Kan.  
J. T. Jones, Asst. M. C. B., Ft. Scott, Kan.  
Central Branch Union Pac. Ry.  
4-84g 479.44 m. 35 lo. 539ft. cars. 23pass cars.  
H. G. Clark, Gen. Supt., St. Louis, Mo.  
C. W. Weller, Div. M. C. B., Atchison, Kan.  
St. Louis, Iron Mountain & Southern Ry.  
4-84g 1,773.47m. 265lo. 9,364ft. cars. 131pass. c.  
E. A. Peck, Gen. Supt., St. Louis, Mo.  
W. H. Harris, M. C. B., De Soto, Mo.  
Mord. Roberts, M. C. B., Baring Cross, Ark.  
Mobile & Birmingham R. R. Co.  
4-9 g. 183 m. 12 lo. 301 cars.  
T. G. Bush, Pres. & Gen. Man., Anniston, Ala.  
J. D. Clark, Supt. & Pur. Agt., Mobile, Ala.  
Mobile & Ohio R. R. 4-84g 687 m. 106 lo. 3,952 c.  
John G. Mann, Gen. Man., Mobile, Ala.  
R. H. Duesberry, Pur. Agt., Mobile, Ala.  
M. T. Carson, Supt. Mach., Jackson, Tenn.  
J. D. Gurganus, M. C. B., Whistler, Ala.  
St. L. Div.: H. W. Clarke, Supt. Ea. St. Louis, Ill.  
A. B. Minton, M. C. B., Murphysboro, Ill.  
G. Manuel, M. C. B., Jackson, Tenn.  
D. O. Smith, M. C. B., Whistler, Ala.  
Mohawk & Malone Ry. (See N. Y. C. & H. R. R. R.)  
Moncton & Bucoche Ry. 4-84g 32 m. 21. 38 c.  
E. G. Evans, Gen. Man., Moncton, N. B.  
W. P. Landry, M. C. B., Moncton, N. B.  
Monongahela River R. R. 4-84g 33 m. 7 lo. 1,395 c.  
J. A. Fickinger, G. M. & P. A., Monongah, W. Va.  
H. G. Bowles, G. M. & P. A., Monongah, W. Va.  
J. B. Dorsey, M. M. & M. C. B., Watson, W. Va.  
Monson R. R. 2 g. 6.16 m. 2 lo. 19c.  
J. F. Kimball, Gen. Man., Wilton, N. H.  
W. L. Estabrooke, Pur. Agt., Monson, Me.  
H. E. Morrill, M. M. & M. C. B., Monson, Me.  
Montana Central Ry. 4-84g 253 m. 21 lo. 835 c.  
(See Great Northern.)  
Montana Union Ry. Co. 4-84g 73 m. 29 lo. 369 c.  
Wm. H. Burns, Gen. Man. & P. A., Butte Mont.  
G. Landoff, M. M. & M. C. B., Anaconda, Mont.  
Monterey & Mex. Gulf Ry. 4-84g 390m. 127 lo. 595c.  
Arthur Monnom, Gen. Man., Monterey, Mex.  
E. Des Esarts, Pur. Agt., Monterey, Mex.  
E. Dragnet, Supt. M. P., Monterey, Mex.  
F. C. Barron, M. M. & M. C. B., Monterey, Mex.  
Montour R. R. 4-84g 12 m. 2 lo. 260 cars.  
U. A. Andrews, Gen. Man. & P. A., Pittsburgh, Pa.  
L. S. Young, Supt., Imperial, Pa.  
Jas. Nelson, M. M. & M. C. B., Imperial, Pa.  
Montpelier & Wells Riv. R.R. 4-84g 45 m. 6 lo. 120 c.  
W. A. Stowell, Gen. Man., Montpelier, Vt.  
F. W. Morse, Pur. Agt., Montpelier, Vt.  
G. Jacobson, M. C. B., Montpelier, Vt.  
C. F. Robinson, M. C. B., Montpelier, Vt.  
Morgan's Louis. & Tex. R.R. (See Southern Pacific.)  
Mount Washington R. R. 4-74g 394 m. 8 lo. 9 cars.  
T. A. Mackinnon, Gen. Man., Boston, Mass.  
J. A. Farrington, Pur. Agt., Boston, Mass.  
John Horne, Supt. Base Mt. Washington, N. H.

Narragansett Pier R. R. 4-84g 84 m. 2 lo. 16 c.  
G. T. Lanphear, Supt. & Pur. Agt., Peacedale, R. I.  
E. Gardner, M. C. B., Peacedale, R. I.  
Nashville, Chattanooga & St. Louis Ry.  
4-9 g. 902.24 m. 163 lo. 4,624 cars.  
J. W. Thomas, G. M., Nashville, Tenn.  
J. W. Thomas, Jr., Pur. Agt., Nashville, Tenn.  
James Cullen, M. M. & O. B., Nashville, Tenn.

# CRANE COMPANY,

MANUFACTURERS OF

## AIR BRAKES.

Also Air Brake Repairs, Air Brake Pipe,  
Air Brake Fittings.

## CHICAGO.

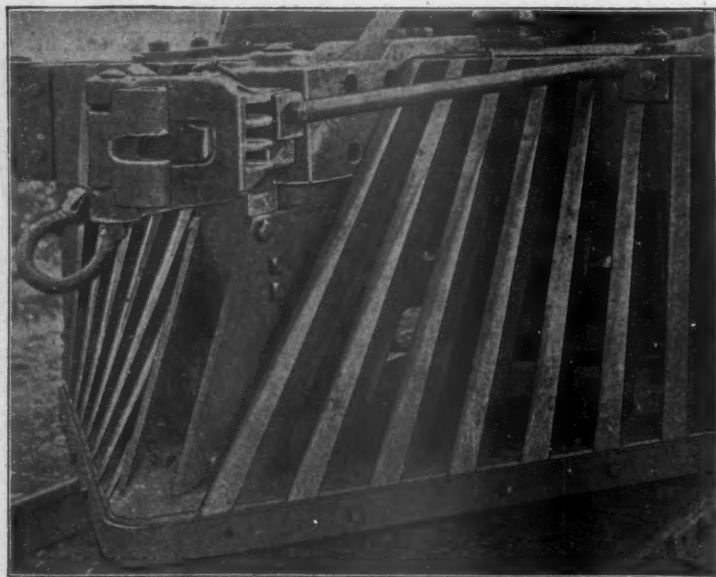
## OFFICES

66 Broadway  
NEW YORK  
941 The Rookery  
CHICAGO  
319 Commercial Bldg  
ST. LOUIS

### GOULD COUPLER Co.

## WORKS

Steam Forge  
BUFFALO, N. Y.  
Malleable Iron  
DEPEW, N. Y.  
Cast Steel  
ANDERSON, IND.



## THE LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

### IT LEADS

In completeness of equipment,  
Comfort of transport,  
Promptness of service,  
Fast and elegant trains.

A. J. SMITH, G. P. & T. A., CLEVELAND, O.

## PENNSYLVANIA THE STANDARD RAILROAD OF AMERICA.

THE ONLY FOUR-TRACK LINE LEADING OUT OF NEW YORK CITY.

## RAILROAD.

Connecting all the principal cities on the Atlantic Coast with those in the Mississippi Valley and on the Great Lakes. Through Trains with Pullman Vestibule, Buffet, Sleeping and Dining Cars attached, between New York, Philadelphia, Washington and Baltimore and Chicago, St. Louis, Cincinnati and Louisville.

BAGGAGE CHECKED TO DESTINATION. FARE ALWAYS AS LOW AS BY ANY OTHER ROUTE.

For tickets, parlor car accommodations, and all desired information, apply at the following offices of the company: No. 205 Washington Street, Boston; No. 1 Astor House, Nos. 435, 944 and 1196 Broadway, and Desbrosses and Cortlandt Street Ferries, New York; Nos. 838 and 1348 Chestnut Street and Broad Street Station, Philadelphia; N. E. corner Baltimore and Calvert streets, Union Station, and Calvert Station, Northern Central Railway, Baltimore; N. E. corner Thirtieth Street and Pennsylvania Avenue, and Baltimore & Potomac Railroad Station, Washington, D. C. S. M. PREVOST, General Manager. J. R. WOOD, General Passenger Agent

Natchitoches & Red River Valley R. R. Co.  
4-8 1/4 g. 16 m. 2 lo. 11 cars.  
L. Caspari, G. Man. & P. A. Natchitoches, L.  
Nelson & Fort Sheppard Ry.  
(See Spokane Falls & Northern Ry. Co.)  
Nevada, California, Oregon Ry. 3 g. 80 m. 4 lo 50 c.  
E. Gest, Gen. Man. Reno, Nev.  
Nevada Central R. R. Co. 3 g. 93 m. 3 lo. 45 c.  
W. J. Phillips, Gen. Man. & P. A. Austin, Nev.  
J. C. Slater, M. M. & M. C. B.  
Nevada County N. G. R. R. 3 g. 23 m. 3 lo. 58 cars  
John F. Kidder, G. Man. & P. A. Grass Valley, Cal.  
Jas. McCormick, M. M. & C. B. Grass Valley, Cal.  
New Brunswick & Prince Edward Island Ry.  
4-8 1/4 g. 36 m. 3 lo. 37 cars.  
Josiah Wood, Gen. Man. Sackville, N. B.  
F. C. Harris, Supt. P. A. & M. M. Sackville, N. B.  
Newburg, Dutchess & Conn. R. R.  
4-8 1/4 g. 58 miles, 8 l. 182 c.  
G. Hunter Brown, Jr., V. P. & Gen. Man.,  
Matteawan, N. Y.  
Gilman D. Holmes, M. M. & C. B.,  
Dutchess Junction, N. Y.  
New England R. R. Co.  
4-8 1/4 g. 558.09 m. 217 lo. 4,769 cars.  
C. Peter Clark, Gen. Man. Boston, Mass.  
Edward Mahler, Pur. Agt. Boston, Mass.  
Thos. Kearsley, G. M. Norwood, Mass.  
T. W. Adams, M. C. B. Norwood, Mass.  
New Jersey & New York Ry.  
4-8 1/4 g. 45 m. 11 lo. 116 c.  
J. D. Hasbrouck, Gen. Man. & P. A.,  
Jersey City, N. J.  
Supt. Hillsdale, N. J.  
Thos. B. Russell, M. M. Hillsdale, N. J.  
L. B. Van Wagner, M. C. B. Hillsdale, N. J.  
New London Northern R. R. (See Central Ver.)  
New Mexico & Arizona (See A. T. & Santa Fe R. R.)  
New Orleans, Fort Jackson & Grand Isle R. R.  
4-8 1/4 g. 61 m. 5 lo. 59 cars.  
J. S. Landry, Supt. & P. A. Algiers, La.  
C. S. Burgis, M. M. & M. C. B. Algiers, La.  
New Orleans & Northwestern Ry. Co.  
4-8 1/4 g. 102 m. 7 lo. 94 cars.  
L. K. Hyde, Rec. & G. M. Titusville, Pa.  
C. G. Vaughn, Pur. Agt. Natchez, Miss.  
J. H. McGill, M. M. Natchez, Miss.  
New Orleans & Southern R. R. 4-8 1/4 g. 60.4 m. 8 l. 140c.  
G. S. Taylor, Rec. New Orleans, La.  
John M. Turner, Gen. Men. New Orleans, La.  
C. B. Beason, M. M. New Orleans, La.  
Newport News & Miss. Val. Co. (See Ch. & O. S. W.)  
4-9 g. 413 m. 92 l. 3,659 cars.  
Newport & Sherman's Valley.  
3 g. 31 m. 4 lo. 64 cars.  
D. Gring, Gen. Man. Newport, Pa.  
C. K. Miller, Pur. Agt. Newport, Pa.  
W. H. Gring, M. M. Newport, Pa.  
N. Y. & Greenwood Lake Ry. (See N. Y., L. E. & W.)  
New York & Northern. 4-8 1/4 g. 61 m. 21 lo. 345 c.  
(See N. Y. Central.)  
N. Y. Central & Hudson River R. R.  
4-8 1/4 g. 987 m. 344 lo. 1,049 pass. c., 26,791 frt. c.  
J. M. Toucey, Gen. Man. New York, N. Y.  
A. Bourn, Pur. Agt. New York, N. Y.  
Wm. Buchanan, Supt. M. P. New York, N. Y.  
Jas. Buchanan, Asst. S. M. P. West Albany, N. Y.  
G. H. Hazelton, Asst. Supt. M. P. Depew, N. Y.  
Mohawk Div.:  
J. R. Leonard, Supt. Albany, N. Y.  
Geo. Van Tassel, M. M. New York, N. Y.  
Jas. Buchanan, M. M. W. Albany, N. Y.  
F. W. Chaffee, M. C. B. W. Albany, N. Y.  
W'n Div.: J. F. Bradfield, Supt. Buffalo, N. Y.  
S. L. White, M. M. Syracuse, N. Y.  
Amos Gould, M. M. E. Buffalo, N. Y.  
J. Macbeth, M. C. B. E. Buffalo, N. Y.  
Peter Smith, M. C. B. E. Rochester, N. Y.  
N. Y. Chic. & St. L. R. R. 4-8 1/4 g. 523 m. 161 lo. 7,609 c.  
A. W. Johnston, Gen. Supt. Cleveland, O.  
M. M. Rodgers, Pur. Agt. Cleveland, O.  
John Mackenzie, Supt. M. P. Cleveland, O.  
East'n Div.: W. L. Blair, Supt. Conneaut, O.  
E. A. Miller, M. M. Conneaut, O.  
West'n Div.: C. D. Gorham, Supt. Ft. Wayne, Ind.  
Geo. James, M. M. Stony Island, Ill.  
New York, New Haven & Hartford R. R.  
4-8 1/4 g. 1,464.21 m. 677 lo. 13,441 cars.  
C. H. Platt, Gen. Supt. New Haven, Conn.  
H. A. Bishop, Pur. Agt. New Haven, Conn.  
F. B. Smith, M. M. New Haven, Conn.  
W. P. Appleyard, M. C. B. New Haven, Conn.  
Lewis Wyler, M. M. Hartford, Conn.  
J. W. Leary, M. M. New Haven, Conn.  
J. T. Brady, M. M. Harlem River, N. Y.  
Old Colony System:  
J. Henney, Jr., Supt. M. P. New Haven, Conn.  
E. G. Allen, Gen. Supt. Boston, Mass.  
R. W. Husted, Pur. Agt. Boston, Mass.  
F. M. Twombly, M. M. Boston, Mass.  
S. P. Willis, M. M. Boston, Mass.  
A. W. Twombly, M. M. Taunton, Mass.  
L. M. Butler, M. M. Valley Falls, R. I.  
N. Y., Ontario & West. Ry. 4-8 1/4 g. 477 m. 133 lo. 6,519c.  
J. E. Childs, Gen. Man. New York, N. Y.  
Chas. A. Draper, Pur. Agt. New York, N. Y.  
Geo. W. West, M. M. & M. C. B.,  
Middletown, N. Y.  
(See Erie R. R.)  
N. Y., Pennsylvania & Ohio R. R.  
New York, Philadelphia & Norfolk R. R.  
4-8 1/4 g. 112 m. 16 lo. 615 c.  
W. A. Patton, V. P. & P. A. Philadelphia, Pa.  
M. M. & M. C. B. Cape Charles, Va.  
New York, Providence & Boston R. R. See N. Y.,  
N. H. & R. R. R.  
N. Y., Susquehanna & W'n. 4-9 g. 157.75 m. 71 lo. 3,539 c.  
Chas. D. McKelvey, Gen. Supt. Jersey City, N. J.  
C. T. Demarest, Pur. Agt. Jersey City, N. J.  
W. C. Ennis, M. M. & C. B. North Paterson, N. J.  
Norfolk, Virginia Beach & Southern R. R.  
3 g. 18 m. 4 lo. 53 c.  
B. P. Holland, Gen. Supt. & P. A. Norfolk, Va.  
R. D. Whitehorn, M. M. Norfolk, Va.  
F. O. Clibourne, M. C. B. Norfolk, Va.

Norfolk & Western Ry. Co.  
4-9 g. 1,570 m. 421 lo. 15,925 cars.  
Henry Fink, Pres. Philadelphia, Pa.  
Jos. H. Sands, Gen. Man. Roanoke, Va.  
E. T. Burnett, Pur. Agt. Roanoke, Va.  
L. P. Ligou, M. M. Bluefield, W. Va.  
S. K. Dickerson, M. M. East Radford, Va.  
R. H. Soule, Supt. M. P. & C. B. Roanoke, Va.  
John Cullinan, M. M. Portsmouth, Va.  
N. W. Norworthy, M. M. Crews, Va.  
Norfolk & Southern R. R. 4-8½ g. 104 m. 14 lo. 308 c.  
M. K. King, Gen. Man. & Pur. Agt. Norfolk, Va.  
G. R. Joughins, M. M. & C. B. Berkley, Va.  
North-Eastern R. R. (S. C.) (See A. Coast Line.)  
Northern New York R. R. 4-8½ g. 56 m. 6 lo. 511 c.  
C. B. Hibbard, Pres. & Gen. Man.  
Tupper Lake, N. Y.  
E. Lalime, Supt., Pur. Agt. & M. M. & C. B. Santa Clara, N. Y.  
Northern Alabama Ry. Co.  
4-9 g. 120 m. 11 lo. 503 cars.  
Sam'l Hunt, G. M. Cincinnati, O.  
F. D. Rhodes, Pur. Agt. Sheffield, Ala.  
J. T. Brumbach, M. M. & C. B. Cincinnati, O.  
Northern California R. R. (See So. Pac. Co.)  
Northern Central Ry. (See Penna. R. R.)  
Northern Ohio Ry. 4-8½ g. 165 m. 11 lo. 345 cars.  
Geo. L. Bradbury, Gen. Man. Indianapolis, Ind.  
T. H. Perry, Pur. Agt. Indianapolis, Ind.  
John T. Clark, M. M. Delphos, O.  
P. Reilly, Supt. Equipment. Lima, Ohio.  
North Pacific R. R. 4-8½ g. 4,977 m. 633 lo. 18,930 c.  
J. W. Kendrick, Gen. Man. St. Paul, Minn.  
F. G. Prest, Pur. Agt. Tacoma, Wash.  
J. Hickey, Supt. M. P. & R. S. St. Paul, Minn.  
Minn. Div.:  
A. E. Law, Supt. Minneapolis, Minn.  
S. L. Bean, M. M. Brainerd, Minn.  
Dak. Div.: C. J. Wilson, Supt. Jamestown, Dak.  
F. N. Risteen, M. M. Fargo, Dak.  
Manitoba Div.:  
G. W. Vanderslice, Sup. Winnipeg, Manitoba.  
J. T. Ford, M. M. Winnipeg, Manitoba.  
Missouri & Yellow Stone Div.:  
F. E. Potter, Act. Supt. Glendive, Mont.  
M. M. Glendive, Mont.  
Montana Div.:  
J. D. Finn, Supt. Livingston, Mont.  
Angus Brown, M. M. Livingston, Mont.  
R. M. Div.: E. J. Pearson, Supt. Missoula, Mont.  
W. S. Clarkson, M. M. Missoula, Mont.  
Idaho Div.: F. W. Gilbert, Supt. Sprague, Wash.  
Wm. Moir, M. M. Sprague, Wash.  
Pac. Div.:  
Jos. McCabe, Supt. Tacoma, Wash.  
H. H. Warner, M. M. Tacoma, Wash.  
North Pacific Coast R. R. 3 g. 94 m. 12 lo. 391 cars.  
J. B. Stetson, G. M. San Francisco, Cal.  
W. F. Russell, Pur. Agt. San Francisco, Cal.  
W. J. Thomas, M. M. & C. B. Sausalito, Cal.  
Northwestern Ohio Ry. (See Pa. Co.)  
North Galveston, Houston & Kansas City Ry. (See Galveston, La. Port & Houston Ry.)  
Ohio Central Lines:  
Toledo & Ohio Central Ry. 4-8½ g. 359 m. 86 lo. 6,494 cars.  
Kanawha & Michigan Ry. 4-8½ g. 168 m. 15 lo. 600 cars.  
J. M. Ferris, Gen. Man. Toledo, O.  
H. A. Cooper, Pur. Agt. Toledo, O.  
J. B. Morgan, M. M. & C. B. Bucyrus, O.  
Ohio & Big Sandy R. R. (See C. & O. Ry. Co.)  
Ohio & Mississippi Ry. (See B. & O. Northwestern.)  
4-9 g. 636 m. 124 lo. 3,823 cars.  
Ohio River R. R. 4-8½ g. 223 m. 29 lo. 1,303 cars.  
Geo. A. Burt, P. & G. M. Parkersburg, W. Va.  
A. H. Thorpe, P. Agt. Parkersburg, W. Va.  
Walter Layman, M. M. Parkersburg, W. Va.  
Ohio River & Charleston Ry. 4-8½ g. 212.24 m.  
Sam'l Hunt, Pres. & G. M. Cincinnati, O.  
T. D. Rhodes, Pur. Agt. Cincinnati, O.  
W. J. Wilcox, M. M. & C. B. Blacksburg, S. C.  
Ohio Southern R. R. 4-9 g. 223 m. 38 lo. 6,265 c.  
F. P. Graf, } Receivers. Springfield, O.  
N. E. Matthews, }  
I. H. Burgoon, Gen. Supt. Springfield, O.  
N. E. Matthews, Pur. Agt. Springfield, O.  
H. M. Sehr, M. M. & C. B. Springfield, O.  
Ohio Valley Ry. (See C. & O. Northwestern.)  
4-9 g. 136 m. 11 lo. 346 c.  
Old Colony R. R. 4-8½ g. 603 m. 238 lo. 4,917 cars.  
(See N. Y., N. H. & H.)  
Omaha & St. Louis Ry. 4-8½ g. 145 m. 17 lo. 450 c.  
John F. Barnard, Rec. Council Bluffs, Ia.  
F. P. Boatman, M. M. Stanberry, Mo.  
Oregon & California R. R. (See Southern Pac. Co.)  
Oregon Improvement Co., owning and operating  
Columbia & Puget Sound R. R., Pacific Coast  
Ry., Seattle & Northern Ry. and Port Town  
send Southern R. R.  
3 and 4-8½ g. 209 m. 20 lo. 492 cars.  
C. J. Smith, Gen. Man. & Rec. Seattle, Wash.  
W. E. Nichols, Pur. Agt. Seattle, Wash.  
D. O'Leary, M. M. Seattle, Wash.  
Oregon Central & Eastern R. R.  
4-8½ g. 138 m. 13 lo. 332 cars.  
Edwin Stone, Man. Corvallis, Ore.  
C. Sullivan, Supt. & Pur. Agt. Corvallis, Ore.  
J. T. Walsh, M. M. & C. B. Corvallis, Ore.  
Oregon Ry. & Nav. Co.  
4-8½ g. 1,059.35 m. 104 l. 3087 c.  
E. McNeill, Pres. & G. M. Portland, Ore.  
F. G. Wheeler, P. Agt. Portland, Ore.  
J. F. Graham, M. M. Portland, Ore.  
Ottawa & Gatineau Ry.  
4-8½ g. 60 m. 4 lo. 50 cars.  
P. W. Resseman, Gen. Supt. Ottawa, Ont.  
H. L. Maltby, Pur. Agt. Montreal, Can.  
Jas. Kay, M. M. & C. B. Aymer, Que.

## P

Pacific Coast Ry. Co. 3 ft. g. 76 m. 6 lo. 193 cars.  
C. O. Johnson, Supt. & Pur. Agt. San Luis Obispo, Cal.  
J. Lind, M. M. & C. B. San Luis Obispo, Cal.  
Paducah, Tennessee & Alabama R. R. & Tenn. Mid-  
land Ry. 4-8½ g. 255 m. 18 l. 585 cars.  
(See Nashville, Chattanooga & St. Louis Ry.)  
Panama R. R. 5 g. 48 m. 38 lo. 983 cars.  
Geo. Whaley, Vice Pres. & Gen. Man. New York, N. Y.  
J. R. Shaler, Supt. Colon, Rep. Col.  
G. Reynaud, Pur. Agt. New York, N. Y.  
M. M. Mott, M. M. Colon, Rep. Col.  
Pecos Val. Ry. & Pecos River R. R. 4-8½ g. 164m.  
6 lo. 820.  
E. O. Faulkner, Rec. G. M. & P. A. Eddy, N. M.  
G. F. Miller, M. M. Eddy, New Mex.  
Pennsylvania & North Western R. R.  
4-9 g. 73 m. 44 lo. 808 cars.  
F. S. Lewis, Gen. Man. & Pur. Agt. Phila. Pa.  
Geo. Van Brunt, M. M. Bellwood, Pa.  
A. Zimmerman, M. C. B. Bellwood, Pa.  
Pennsylvania Company operating  
Pitts. Fort Wayne & Chicago; Massillon & Clev.  
So. Chi. & South'n State Line & Indiana City; Pitts-  
burgh, Youngstown & Ashtabula; Clev. & Pitts.;  
Erie & Pitts.; Newcastle & Ben. Val. and T. W. V.  
& O.; Pittsburgh, Ohio Valley & Cincinnati.  
4-9 g. 1,075.20 m. 508 lo. 40,656 cars.  
Gen. Divs. (1), (2), (3), (4) and (5).  
J. T. Brooks, 2d V. Pres. Pittsburgh, Pa.  
L. F. Loree, Gen. Man. Pittsburgh, Pa.  
A. W. Sumner, Pur. Agt. Columbus, O.  
Theo. N. Ely, Ch. of M. P. Philadelphia, Pa.  
Geo. L. Potter, Supt. M. P. Fort Wayne, Ind.  
1) Erie Div.: 205m.  
A. B. Starr, Supt. Allegheny City.  
W. F. Beardsley, M. M. Allegheny City, Pa.  
P. F. Smith, Jr., M. M. Crestline, O.  
2) W'n Div.: 304 m. C. D. Law, Supt. Ft. Wayne, Ind.  
Bernard Fitzpatrick, M. M. Ft. Wayne, Ind.  
J. A. Graham, For. Car Rep. Ft. Wayne, Ind.  
3) Erie & Ashtabula Div.: 224 m.  
H. W. Byers, Supt. Lawrence Junc., Pa.  
G. J. Parkin, M. M. Erie, Pa.  
4) Cleveland & Pitts'g Div.: 217 m.  
W. H. Scriven, Supt. Cleveland, O.  
Geo. P. Sweeley, M. M. Wellsville, Ohio.  
5) Toledo Div.: 126 m. W. H. Potter Supt. Toledo, O.  
Pennsylvania R. R. Co.'s Roads. (7 Gen. Divs.)  
4-9 g. 4,045 m. 2,281 loco. 83,142 cars.  
S. M. Prevost, Gen. Man. Philadelphia, Pa.  
Samuel Porcher, Act. Pur. Agt. Philadelphia, Pa.  
F. D. Casanave, Gen. S. M. P. Altoona, Pa.  
1) Pennsylvania R. R. Divs.  
Frank L. Sheppard, Gen. Supt. Altoona, Pa.  
W. W. Atterbury, Supt. M. P. Altoona, Pa.  
G. W. Stratton, M. M. Altoona, Pa.  
Jno. P. Levan, Gen. For. C. Shps. Altoona, Pa.  
Phila. Div.: Tho. Guicker, Supt. W. Phila. Pa.  
Richard Durbin, M. M. W. Philadelphia, Pa.  
L. W. Van Houten, Gen. For. C. S. W. Phila. Pa.  
Schuylkill Div.:  
W. H. Meyers, Supt. Reading, Pa.  
Mid. Div.:  
Geo. W. Creighton, Supt. Harrisburg, Pa.  
C. L. Caum, M. M. Harrisburg, Pa.  
W. F. Eberle, Gen. For. C. S. Harrisburg, Pa.  
Altoona Div.: R. E. Marshall, Supt. Altoona, Pa.  
Pitts. Div.: Robert Fitzpatrick, Supt. Pittsburgh, Pa.  
D. O. Shaver, M. M. Pittsburgh, Pa.  
W. Pa. Div.: D. M. Watt, Supt. Allegheny City.  
H. H. Falls, Gen. For. C. S. Blairsville, Pa.  
Fred. Div.: A. W. Moss, Supt. York, Pa.  
A. O. Baker, M. M. Columbia, Pa.  
Tyrone Div.: S. S. Blair, Supt. Tyrone, Pa.  
J. A. Beamer, M. M. Tyrone, Pa.  
Lew. Div.:  
Victor Wierman, Supt. Lewistown, Pa.  
C. S. Thomas, M. M. Lewistown, Pa.  
Red. Div.: W. B. McCaleb, Supt. Bedford, Pa.  
And. Green, For. C. S. State Line, Pa.  
Monong. Div.: D. H. Lovell, Supt. Pittsburgh, Pa.  
Wm. Linsinger, Gen. Foreman Pittsburgh, Pa.  
2) United R. R. of N. J. Divs.:  
F. Wolcott Jackson, Gen. Supt. Jersey City, N. J.  
H. S. Hayward, Supt. M. P. Jersey City, N. J.  
H. Canfield, M. M. Hoboken, N. J.  
N. Y. Div.: W. Bannard, Supt. Jersey City, N. J.  
H. Canfield, M. M. Hoboken, N. J.  
J. W. Sanford, M. M. Meadows, N. Y.  
Belv. Div.: A. P. Gest, Supt. Lambertville, N. J.  
R. McDowell, M. M. Lambertville, N. J.  
Amboy Div.: W. Brown, Supt. Camden, N. J.  
Thos. Kerr, M. M. So. Amboy, N. J.  
H. Hill, M. M. Camden, N. J.  
W. McAllister, M. M. Camden, N. J.  
P. S. Bogart, Gen. For. So. Amboy, N. J.  
3) West Jersey & Seashore R. R.  
A. O. Dayton, Gen. Supt. Camden, N. J.  
4) Phila., Wilm. & Balt. R. R.  
H. F. Kenney, Gen. Supt. Philadelphia, Pa.  
Clarence Mendenhall, S. M. P. Philadelphia, Pa.  
C. G. Turner, M. M. Wilmington, Del.  
5) Phila. & Erie R. R. Divs.:  
J. M. Wallis, Gen. Supt. Williamsport, Pa.  
Edw. D. Nelson, Supt. Mo. Fo. Williamsport, Pa.  
Northern Central Ry.  
J. M. Wallis, Gen. Supt. Williamsport, Pa.  
Edw. D. Nelson, Supt. M. P. Williamsport, Pa.  
J. M. Coale, M. M. Baltimore, Md.  
G. W. Demarest, Gen. For. Baltimore, Md.  
Elin. & Can. Divs.: S. Meade, Supt. Elmira, N. Y.  
Jas. Strode, M. M. Elmira, N. Y.  
J. C. Dyott, Gen. For. Elmira, N. Y.  
Pensacola, Ala. & Tenn. Ry. 5 g. 26 m. 3 lo. 93 cars.  
S. R. Dishman, Pres. & P. A. Pensacola, Fla.  
Peoria & Pekin Union Ry. 4-8½ g. 62 m. 20 lo. 350 c.  
F. L. Tompkins, Supt. & P. Agt. Peoria, Ill.  
Jas. W. Hill, M. M. & C. B. Peoria Ill.

Peoria, Decatur & Evansville Ry.  
4-8½ g. 330m. 33 lo. 1,808 cars.  
E. O. Hopkins, Gen. Man. & Rec. Evansville, Ind.  
W. J. Lewis, Pur. Agt. Evansville, Ind.  
C. C. Robinson, M. M. & C. B. Mattoon, Ill.  
Perkionan Ry. 4-8½ g. 39 m. Locos. and cars  
leased from Reading R. R. Co.  
H. Boyd, P. A. Norristown, Pa.  
Philadelphia & Erie R. R. (See Penna. R. R.; (5) Div.)  
Phila. Harb. & Pitts. R. R. (See Phila. & Read. R. R.)  
Philadelphia & Reading R. R.  
4-8½ g. 1,153 m. 784 lo. 28,581 cars.  
Theodore Voorhees, 1st V. P. Philadelphia, Pa.  
A. Foster, Pur. Agt. Philadelphia, Pa.  
L. B. Paxson, Supt. M. P. & R. E. Reading, Pa.  
E. E. Davis, A. S. M. P. & R. E. Reading, Pa.  
J. H. Rankin, M. C. B. Reading, Pa.  
I. A. Sweigard, G. Supt. Philadelphia, Pa.  
Phila., Reading & New England R. R.  
4-8½ g. 181 m. 37 l. 607 cars.  
Jas. K. O. Sherwood, Rec. New York, N. Y.  
W. J. Martin, G. S. & Pur. Agt. Hartford, Conn.  
E. M. Humstone, M. M. & C. B. Hartford, Conn.  
Phila., Newtown & New York R. R. 4-8½ g. 23 m.  
W. M. Geary, Supt. Philadelphia, Pa.  
Howard Boyd, Pur. Agt. Norristown, Pa.  
Phila. Wilmington & Balt. R. R. (See Penna. R. R.)  
Piedmont Air Line (See Rich. & Danville.)  
Pine Bluff & Eastern R. R. Co. 3 ft. g. 204.4m. 2 lo. 20c.  
S. W. Fordyce, Receiver. St. Louis, Mo.  
H. E. Martin, Supt. Pine Bluff, Ark.  
W. H. Hall, M. M. Pine Bluff, Ark.  
Pittsburgh, Akron & Western R. R.  
(See Northern Ohio Ry.)  
Pittsburgh, Brady's Bend & Lake Erie R. R.  
Jos. Pool, Pres. New York, N. Y.  
Harwood R. Pool, Sec'y. New York, N. Y.  
Executive Office, 62 Cedar St., New York, N. Y.  
In course of construction.  
Pitts. & Castle Shannon R. R. 3-4 g. 6¼ m. 4 lo. 355 c.  
E. J. Reamer, Supt. & Pur. Agt. Pittsburgh, Pa.  
Holmes Ward, M. M. Castle Shannon, Pa.  
W. E. Long, M. C. B. Pittsburgh, Pa.  
Pitts. & Lake Erie R. R. and lessees of Pitts. McK. &  
Yough R. R. 4-8½ g. 429.13 m. 117 lo. 5,757 c.  
G. M. Beach, Gen. Supt. Pittsburgh, Pa.  
R. Evans, Pur. Agt. Pittsburgh, Pa.  
L. H. Turner, M. M. & C. B. McKee's Rocks, P. O. Pa.  
Pitts. & West. Ry.: 3 & 4-8½ g. 363m. 119 lo. 5,727 c.  
Thee. M. King, Pres. & Rec. Allegheny, Pa.  
R. B. Campbell, G. M. Baltimore, Md.  
J. V. Patton, Gen. Supt. Pittsburgh, Pa.  
R. Flaney, Jr., Pur. Agt. Allegheny, Pa.  
Frank T. Hyndman, M. M. Allegheny, Pa.  
Thos. Anderson, M. C. B. Allegheny, Pa.  
H. O. Dulkie, Supt. West. & Lake Div. Allegheny, Pa.  
I. N. Kalbaugh, M. M. Allegheny, Pa.  
Pittsburgh, Chartiers & Youghiogheny Ry.  
4-8½ g. 17 m. 7 lo. 80 c.  
J. B. Safford, Supt. & Pur. Agt. McKee's Rocks, Pa.  
Pittsburgh, Bradford & Buffalo Ry. (See Pitts. & West.)  
Pittsburgh, Cincinnati, Chicago & St. Louis Ry.  
4-9 g. 1,075.20 m. 508 lo. 40,667 cars.  
J. T. Brooks, 2d V. Pres. Pittsburgh, Pa.  
L. F. Loree, Gen. Man. Pittsburgh, Pa.  
H. O. Hukill, Pur. Agt. Pittsburgh, Pa.  
S. P. Bush, Supt. M. P. Columbus, O.  
R. Fitzpatrick, M. M. Columbus, O.  
J. B. Swann, For. C. S. Columbus, O.  
Pitts. Div.: G. L. Peck, Supt. Pittsburgh, Pa.  
Michael Dunn, M. M. Dennison, O.  
J. B. Swann, For. C. S. Dennison, O.  
Ind. Div.: F. G. Darlington, Supt. Indianapolis, Ind.  
Wm. Swanson, M. M. Indianapolis, Ind.  
P. H. McGraw, For. C. S. Indianapolis, Ind.  
Chic. Div.: C. H. Walton, Supt. Logansport, Ind.  
W. C. Pennock, M. M. Logansport, Ind.  
J. Hannon, For. C. S. Logansport, Ind.  
Indianapolis & Vincennes R. R.  
M. W. Mansfield, Supt. Indianapolis, Ind.  
Jas. Landers, Road For. Eng. Indianapolis, Ind.  
Pittsburgh, St. Wayne & Chicago Ry. (See Penna. Co.)  
Pittsburgh, McK. & Yough. (See P. & L. E.)  
Pittsburgh, Shenango & Lake Erie Ry.  
4-8½ g. 182 m. 30 lo. 1,985 c.  
J. T. Blair, G. Man. Greenville, Pa.  
W. G. Sargeant, Pur. Agt. Meadville, Pa.  
E. B. Gilbert, M. M. & C. B. Shenango, Pa.  
Pittsburgh, Youngstown & Ashtabula (See Penn. Co.)  
The Plant System, operating the Savannah, Florida  
& Western Ry.  
4-9 g. 569 m. 92 lo. 2,228 cars.  
Bradford Dunham, G. Supt. Savannah, Ga.  
M. F. Loughman, Pur. Agt. New York, N. Y.  
Supt. M. P. Savannah, Ga.  
G. M. D. Riley, M. M. Savannah, Ga.  
T. M. McDonough, M. M. Thomasville, Ga.  
South Florida R. R. Co. 4-9 g. 306 m. 32 lo. 663c.  
H. A. Ford, Supt. Sanford, Fla.  
A. B. Allen, M. C. B. Sanford, Fla.  
Charleston & Savannah Ry.  
4-8½ g. 120 m. 23 lo. 751 cars.  
C. S. Gadsden, Supt. Charleston, S. C.  
M. F. Loughman, Pur. Agt. New York, N. Y.  
G. M. D. Riley, M. M. & C. B. Savannah, Ga.  
Alabama Midland Ry.  
4-8½ g. 208 m. 18 lo. 450 cars.  
C. O. Parker, Supt. Montgomery, Ala.  
W. J. McLean, M. M. Montgomery, Ala.  
Brunswick & Western.  
4-9 g. 170 m. 23 lo. 591 cars.  
G. W. Haines, S. & P. A. Waycross, Ga.  
D. B. Overton, M. M. & C. B. Brunswick, Ga.  
Silver Springs, Ocala & Gulf Ry.  
4-8½ g. 80 m. 4 lo. 26 c.  
J. W. Craig, Supt. High Springs, Fla.  
Pontiac, Oxford & Northern R. R.  
4-8½ g. 100 m. 6 lo. 121 c.  
Wm. C. Sanford, G. S. & P. A. Pontiac, Mich.  
F. H. Neward, M. M. & C. B. Pontiac, Mich.



CUYAHOGA FALLS, O.

## SHORE LINE

Through Train Service from either city. **Between BOSTON and NEW YORK.**

10.00 a. m. "BAY STATE LIMITED," Parlor Cars only. Special Tickets required. Buffet Service through. Due at 8.00 p. m.

10.03 a. m. "DAY EXPRESS," Buffet Parlor Cars and Day Coaches. Due at 4.30 p. m.

1.03 p. m. "AFTERNOON EXPRESS," Buffet Parlor Cars and Day Coaches. Due at 7.30 p. m.

\*3.00 p. m. "SHORE LINE EXPRESS," Parlor Cars, Parlor Smoking Car and Day Coaches. Dining Car between Boston and New London. Due at 9.00 p. m.

\*5.00 p. m. "GILT EDGE EXPRESS," Parlor Cars, Parlor Smoking Car and Day Coaches. Dining Car between Boston and New London. Due at 11.00 p. m.

\*12.00 O'CLOCK "MIDNIGHT EXPRESS," Compartment Sleeping Cars and Day Coaches. Open for occupation at 9.15 p. m. Due at 7.00 a. m.

\*Week Days and Sundays.

NEW YORK, NEW HAVEN &amp; HARTFORD R. R.

C. T. HEMPSTEAD, A. C. KENDALL, GEO. L. CONNOR,  
G. P. A. New Haven System. G. P. A. Old Colony System. Pass. Traffic Mgr.  
JANUARY 31, 1896.

## The Indian and Eastern Engineer

An Illustrated Weekly Journal for Engineers  
in India and the East.

The *Indian and Eastern Engineer* contains the latest and most authentic information on all subjects connected with Engineering enterprise in India and the East.

Correspondence invited on any subject which may be of interest to the profession

**RATE OF SUBSCRIPTION** (payable in advance, including a copy of the *Indian and Eastern Engineer's* Diary, and postage): . . .

<b>Indian Rates.</b>	<b>English Rates.</b>
YEARLY, - - Rs. 20	YEARLY, - - 40s.

Published at 137 Canning Street, CALCUTTA.

London Office: 28 Victoria Street, WESTMINSTER, S. W.

## NOW READY! Reminiscences of a Railroad Engineer

By W. HASELL WILSON, C. E.

THIS valuable contribution to Railroad History, recently published in the **RAILWAY WORLD**, is now ready for delivery in book form. A large number of copies have already been ordered. Price, \$1.00.

American Engineer, Car Builder and Railroad Journal,

140 NASSAU STREET, - - - NEW YORK CITY.

## INVALUABLE.

"I have been using one of the Waterman Ideal fountain pens for some time, and take pleasure in saying that I find it an invaluable pocket companion."—WM. McKINLEY.

Try it, and whether you vote for McKinley or not you will vote for our pen every time.

### YOUR MONEY BACK IF YOU DON'T.

Ask your stationer, or send for price-list to . . .

L. E. WATERMAN CO., 155 & 157 Broadway, N. Y.

Pontiac Pacific Junc. Ry. 4-8½ g. 70 m. 4 lo. 62 cars.  
W. D. Harris, *Man. Dir.*.....Ottawa, Ont.  
H. L. Malby, *P. A.*.....Montreal, Can.  
Jas. Key, *M. M. & M. C. B.*.....Aylmer, Que.

Port Royal & Augusta Ry.  
(See Charleston & Western Carolina Ry.)  
Port Royal & Western Carolina Ry.  
(See Charleston & Western Carolina Ry.)

Portland & Rochester R.R. 4-8½ g. 5.5 m. 13 lo. 284 c  
J. W. Peters, *Supt. & Pur. Agt.*.....Portland, Me.  
E. H. C. Thompson, *M. M. & M. C. B.*.....Portland, Me.  
Portland & Rumford Falls Ry.

4-8½ g. 57 m. 9 l. 78 cars.  
E. L. Lovejoy, *Supt.*.....Rumford Falls, Me.  
W. B. Davis, *M. M.*.....Rumford Falls, Me.  
Port Jervis, Monticello & New York.

4-8½ g. 41.5 m. 3 lo. 22 cars.  
S. D. Lake, *G. S. & Pur. Agt.*.....Port Jervis, N. Y.  
Port Townsend Southern R. R.

(See Oregon Improvement Co.)  
Potomac, Fred. & Pied. R. R. 3 g. 38 m. 2 lo. 37  
W. H. Richards, *G. M. & P. A.*.....Fredericksburg, Va.  
W. F. Johnson, *M. M.*.....Fredericksburg, Va.  
Poughkeepsie & Eastern.

4-8½ g. 40 m. 3 l. 60 c.  
E. C. Osborne, *Gen. Man.*.....Poughkeepsie, N. Y.  
Chas. H. Strong, *Supt. & M. M.*.....Poughkeepsie, N. Y.

Powellton & Pocahontas R. R.  
4-8½ g. 9 m. 2 lo. 36 cars.

E. Powell, *Pres.*.....Powellton, W. Va.  
A. T. Massey, *Pur. Agt.*.....Powellton, W. Va.  
W. T. Layton, *M. M.*.....Powellton, W. Va.  
W. S. Miller, *M. C. B.*.....Powellton, W. Va.  
Prince Edward Island Ry. (See Intercolonial Ry.)

Profile & Franconia Notch R. R.  
(See Concord & Montreal R. R.)  
Prov. & Springfield R.R. Leased to N.Y. & N.E.R.R.

Pullman Palace Car Co. 2,486 passenger cars.  
Geo. M. Pullman, *Pres.*.....Chicago, Ill.  
T. H. Wickes, *V. Pres.*.....New York, N. Y.  
Geo. F. Brown, *Gen. Man.*.....Chicago, Ill.  
Wm. A. Angell, *West'n Pur. Agt.*.....Chicago, Ill.  
S. W. Bretzfeld, *East'n Pur. Agt.*.....New York, N. Y.  
Arthur M. Parent, *Manager* Pullman Works.  
Pullman, Ill.  
H. M. Pfleger, *Chief Mech. Insp.*.....Chicago, Ill.

### Q

Quebec & Lake St. John Ry. 4-8½ g. 230 m. 14 l. 314 c.  
J. G. Scott, *Sec. & Manager*.....Quebec, Can.  
A. Vallerand, *Pur. Agt.*.....Quebec, P. Q.  
Jno. Campbell, *M. M.*.....Quebec, P. Q.  
Quebec Central Ry. 4-8½ g. 215 m. 15 lo. 514 cars.  
Frank Grundy, *Gen. Man.*.....Sherbrooke, P. Q.  
A. H. Anderson, *P. A.*.....Sherbrooke, P. Q.  
Jas. Selveright, *M. M. & M. C. B.*.....Sherbrooke, P. Q.  
Quincy, Omaha & Kan. City Ry. 4-8½ g. 136 m. 9 l. 142 c.  
J. M. Savin, *Gen. Man.*.....Quincy, Ill.  
J. Voorhis, *M. M. & M. C. B.*.....Quincy, Ill.

### R

Raritan River R. R. 4-8½ g. 16 m. 3 lo. 33 c.  
Frank H. Earle, *Pres. & G. M.*.....Jersey City, N. J.  
F. Hoffman, *Supt.*.....South Amboy, N. J.  
C. H. Slisson, *P. A.*.....Jersey City, N. J.

Raleigh & Western Ry. Co.  
4-9 g. 20 m. 1 lo. 150 cars.  
S. A. Henszey, *G. M. & P. A.*.....Egypt, N. C.  
Richmond & Danville R. R. Co. (See Southern Ry.)  
Richmond & Petersburg R.R. (See A. I. Coast Line.)  
Richmond, Fredericksburg & Potomac R. R.

4-8½ g. 89 m. 27 lo. 153 cars.  
T. L. Courtney, *Supt. & Pur. Agt.*.....Richmond, Va.  
J. T. Bryant, *M. M.*.....Richmond, Va.  
Z. L. Trainham, *M. C. B.*.....Richmond, Va.  
Richmond, Nicholasville, Ironton & Beattyville Ry.

4-8½ g. 31 m. 4 lo. 28 cars.  
Joan MacLeod, *Rec.*.....Louisville, Ky.  
W. H. Adams, *Supt.*.....Louisville, Ky.  
K. MacLeod, *P. A.*.....Louisville, Ky.  
Jonn Farrell, *G. For. & M. C. B.*.....Richmond, Ky.

Rio Grande Western Ry.  
4-8½ g. 559 m. 74 lo. 771 c.  
D. C. Dodge, *Gen. Man.*.....Denver, Colo.  
Q. Lamplugh, *M. M. & M. C. B.*.....Salt Lake City, Utah

Rio Grande Southern R.R. 3 g. 180 m. 35 lo. 869 c.  
Edward T. Jeffery, *Pres.*.....Denver, Col.  
W. D. Lee, *Gen. Supt.*.....Denver, Col.

Rock Island & Peoria Ry. 4-8½ g. 118 m. 23 l. 570 c.  
H. S. Cable, *V. P. & G. M.*.....Rock Island, Ill.  
H. F. Greenough, *Supt. & P. A.*.....Rock Island, Ill.  
Joseph Elder, *M. M. & M. C. B.*.....Peoria, Ill.

Rome, Watertown & Ogdensburg R. R. N. Y. C. & H. R. R. R. Lessee.  
100 lo. 3,934 cars.  
J. M. Toucey, *Gen. Man.*.....New York, N. Y.  
E. G. Russell, *Supt.*.....Watertown, N. Y.  
Allan Bourn, *Pur. Agt.*.....New York, N. Y.  
Wm. Buchanan, *S. M. P. R. S.*.....New York, N. Y.  
P. T. Lonergan, *M. M.*.....Oswego, N. Y.

### S

Sabine & East Texas Ry. (See So. Pac.)  
Saginaw, Tuscola & Huron R. R.  
4-8½ g. 87 m. 9 l. 192 c.

Wm. L. Webber, *Pres., G. M. & P. A.*.....Saginaw, Mich.

Wm. L. Kerr, *M. M. & M. C. B.*.....Saginaw, Mich.  
Saginaw Valley & St. Louis R.R. (See Lan. & North'n.)  
St. Augustine & South Beach Ry. 3 g. 5 m. 2 l. 2 c.

H. J. Ritchie, *P. & G. M.*.....St. Augustine, Fla.  
G. H. Bruer, *Pur. Agt.*.....St. Augustine, Fla.  
W. J. Mack, *M. M.*.....Anastasia, Fla.

St. Johns & Lake Eustis Ry.  
3 g. 52 m. 1 lo. 1 car.  
C. P. Lovell, *Rec. & Gen. Man.*.....Leesburg, Fla.  
P. L. McAttee, *Pur. Agt.*.....Leesburg, Fla.  
D. B. Young, *M. M.*.....Leesburg, Fla.

St. Johnsbury & Lake Champlain R. R.  
4-8½ g. 132 m. 18 lo. 340 cars.  
H. E. Folsom, Supt. .... Lyndonville, Vt.  
J. A. Farrington, Pur. Agt. .... Boston, Mass.  
Henry Bartlett, Supt. M. P. .... Boston, Mass.  
J. T. Chamberlain, M. C. B. .... Boston, Mass.

St. Joseph & Grand Island R. R.  
4-8½ g. 445 m. 36 lo. 1,456 cars.  
W. P. Robinson, Jr., Gen. Man. .... St. Joseph, Mo.  
G. D. Berry, Pur. Agt. .... St. Joseph, Mo.  
A. C. Hinckley, M. M. .... St. Joseph, Mo.

St. Louis, Cape Girardeau & Ft. Smith Ry.  
4-8½ g. 94 m. 9 l. 125 cars.  
E. S. McCarty, Gen. Man. Cape Girardeau, Mo.  
Louis H. Luck, Rec. & P. A. Cape Girardeau, Mo.  
A. W. Quackenbush, Supt. of M. & C. B. Cape Girardeau, Mo.

St. Louis & Hannibal Ry. 4½ g. 103 m. 7 lo. 145 c.  
J. A. Jorcan, Gen. Man. & P. A. Hannibal, Mo.  
Wm. P. Raider, M. M. .... Hannibal, Mo.

St. Louis & San Francisco Ry. (See A., T. & S. F. R. R.)

St. Louis, Alton & Springfield R. R. (See St. L., C. & St. P. Ry.)

St. Louis, Alton & Terre Haute R. R. (See Ill. Cent. R. R.)

St. Louis, Chicago & St. P. R. R.  
4-8½ g. 110 m. 13 lo. 2,857 cars.  
Joseph Dickson, Receivers.  
Charles E. Kimball, Receivers.  
Henry W. Gays, G. M. & P. A. St. Louis, Mo.  
W. E. Killen, M. M. & C. B. Jerseyville, Ill.

St. Louis, Peoria & Northern Ry.  
4-8½ g. 102 m. (Inc. S. L. & P.) 10 lo. 869 c.  
Wm. E. Guy, G. M. & P. A. St. Louis, Mo.

St. Louis Southwestern Ry. Co. of Texas.  
4-8½ g. 1,223 m. 137 lo. 4,539 cars.  
J. A. Eason, Gen. Supt. .... Tyler, Tex.  
A. Gould, P. A. .... St. Louis, Mo.  
R. M. Gailbraith, Gen. M. M. Pine Bluff, Ark.  
J. M. Scroggins, M. M. .... Tyler, Tex.

St. Louis, Iron Mt. & So'n Ry. (See Mo. Pac.; (4) Div.)

St. Louis, Kar City & Colorado R. R.  
4-8½ g. 60 m. 2 l. 52 cars.  
Adiel Sherwood, Receiver. .... St. Louis, Mo.  
W. M. Mitchell, Man. .... St. Louis, Mo.

St. L., Keokuk & No. W'n Ry. (See C., B. & Q.)

St. Paul & Duluth R. R. 4-8½ g. 247 m. 65 lo. 2,307 c.  
A. B. Plough, Gen. Man. .... St. Paul, Minn.  
W. N. Schoff, Pur. Agt. .... St. Paul, Minn.  
G. D. Brooke, M. M. & C. B. St. Paul, Minn.

Salisbury & Harvey Ry. 4-8½ g. 52 m. 2 lo. 35c.  
A. Sherwood, G. M. & P. A. Hillsboro, N. B.  
T. Beck, M. C. B. .... Hillsboro, N. B.

San Antonio & Aransas Pass Ry.  
4-8½ g. 387.4 m. 60 lo. 1,439 cars.  
M. D. Monserrate, Gen. Man. San Antonio, Tex.  
T. B. Palfrey, P. A. .... San Antonio, Tex.  
G. W. Butcher, M. M. & C. B. San Antonio, Tex.

San Diego, Cuyamaca & Eastern Ry.  
4-8½ g. 25.37 m. 2 lo. 39 cars.  
W. S. Waterman, G. M. G. S. & P. A.

Sandy River R. R. 2 g. 18 m. 4 lo. 35 cars.  
Josiah Maxey, G. M. .... Gardiner, Me.  
P. H. Winslow, Pur. Agt. .... Gardiner, Me.  
E. Greenwood, M. M. .... Phillips, Me.

Sandusky & Columbus Short Line.  
(See Col. S. & H. Ry. Co.)

Sanford & St. Petersburg R. R. (See Plant System)

San Francisco & No. Pac. Ry.  
4-8½ g. 165 m. 18 lo. 538 cars.  
H. C. Whiting, G. M. & P. A. San Francisco, Cal.  
John Bonner, M. M. .... Tiburon, Cal.  
J. P. Samuelson, M. C. B. .... Tiburon, Cal.

San Pete Valley R. R. 3 g. 51 m. 3 lo. 45 cars.  
T. Bruback, Gen. Man. .... Salt Lake City, U. T.  
H. S. Kerr, Supt. & P. A. .... Mantle, Ut.  
Wm. Watson, M. M. .... Mantle, Ut.  
P. Wood, M. C. B. .... Mantle, Ut.

Santa Fe Southern Ry. 3 g. 40 m. 3 lo. 42 cars.  
T. J. Helm, Gen. Man. .... Santa Fe, N. Mex.  
Santa Fe, Prescott & Phoenix Ry. Co.  
4-8½ g. 197.8 m. 10 lo. 91 cars.  
F. M. Murphy, Pres. & G. M. Chicago, Ill.  
O. H. Jackson, M. M. .... Prescott, Ariz.

Sault Ste. Marie & Northwestern R. R. (See Chi. St. P. Minn. & Omaha Ry.)

Savannah, Florida & W'n Ry. (See Plant System.)

Sav. Griffin & No. Ala. R. R. Op. by Central (Ga.)

Seaboard Air Line, operating  
Seaboard & Roanoke, Roanoke & Tar River, Raleigh & Gaston, Raleigh & Augusta Air Line, Carolina Central, Durham & Northern Georgia, Carolina & Northern and Murfreesboro Railroads.

Seaboard Air Line. 4-8½ g. 950 m. 130 l. 2,513 c.  
E. St. John, F. P. & Gen. Man. Portsmouth, Va.  
John Warwick, G. Pur. A. Portsmouth, Va.  
Geo. P. Johnson, Supt. Car Service, Portsmouth, Va.

Wm. T. Reed, Supt. M. P. & M. Portsmouth, Va.

C. B. Royal, M. M. .... Portsmouth, Va.  
James Maglenn, M. M. .... Raleigh, N. C.  
F. H. McGee, M. M. .... Abbeville, S. C.  
D. W. Ballentine, M. C. B. Portsmouth, Va.

Seaboard Ry. of Alabama. 3-6 g. 324 m. 5 lo. 48 c.  
S. T. Prince, Rec. .... Mobile, Ala.  
W. J. Best, G. M. .... New York, N. Y.

Seattle, Lake Shore & Eastern Ry. (See Northern Pacific Co.)

Seattle & Northern Ry. (See Ore. Improvem't Co.)

Sharpsville R. R. 4-8½ g. 23 m. 4 lo. 4 cars.  
J. V. Patton, P. & Gen. Man. .... Pittsburgh, Pa.  
S. K. Harris, Pur. Agt. .... Sharpsville, Pa.  
Jas. Glass, M. M. .... Sharpsville, Pa.

Shepaug, Litchfield & Northern R. R.  
4-8½ g. 38 m. 4 lo. 48 cars.  
C. H. Platt, Gen. Man. .... New Haven, Conn.  
J. E. Martin, Supt. & Pur. A. Danbury, Conn.  
A. J. Broughel, M. M. & C. B. Hawleyville, Ct.

Sherman, Shreveport & Southern Ry. Co.  
4-8½ g. 153 m. 10 lo. 141 cars.  
E. M. Alvord, G. S. & P. A. Greenville, Tex.  
Jas. Long, M. M. & C. B. Greenville, Tex.

Sioux Lake Ry. Co. 4-8½ g. 7 m. 1 lo. 520 cars.  
C. A. Carmichael, Supt. .... Perry, N. Y.  
John A. Dalsiel, Pur. Agt. .... Rochester, N. Y.

Sliver Springs, Ocala & Gulf R. R. (See Plant System.)

Sioux City, O'Neill & Western Ry.  
4-8½ g. 129 m. 6 lo. 355 cars.  
F. C. Hills, Rec. & Pur. Agt. .... Sioux City, Ia.

T. J. Roope, M. M. & C. B. Sioux City, Ia.  
Sioux City & Northern R. R.  
4-8½ g. 97 m. 12 l. 485 cars.  
W. Hough, Receivers.  
S. J. Beals, Receivers.  
G. W. Oakley, Pur. Agt. .... Sioux City, Ia.  
T. Roope, M. M. .... Sioux City, Ia.

Sioux City & Pacific and 4-8½ g. 107 m. 11 lo. 370 c.  
Fremont, Elkhorn & Mo. Val. R. R.  
3 and 4-8½ g. 5,030.75 m. 1,010 l. 4,052 cars.  
Geo. F. Bidwell, Gen. Man. .... Omaha, Neb.  
Chas. Hayward, Pur. Agt. .... Chicago, Ill.  
S. A. Teal, M. M. .... Missouri Valley, Ia.  
W. H. Ramseyer, M. C. B. Missouri Valley, Ia.

Skaneateles R. R. 4-8½ g. 5 m. 2 lo. 6 cars  
J. McNamara, Man., Supt. & Pur. Agt. Skaneateles, N. Y.

M. Fennell, M. M. & C. B. Skaneateles, N. Y.

Somerset Ry. 4-8½ g. 4 m. 6 lo. 54 cars  
W. M. Ayer, Supt. & Pur. Agt. .... Oakland, Me.  
C. Crowell, M. M. .... Oakland, Me.  
S. P. Mosher, M. C. B. .... Oakland, Me.

Sonora Ry. (See A., T. & Santa Fe R. R.)

South Atlantic & Ohio R. R. 4-9 g. 71 m. 10 l. 321 c.  
John C. Haskell, Gen. Man. & Pur. Agt. Bristol, Va.

John R. King, M. M. .... Bristol, Va.

South Carolina & Georgia R. R.  
4-8½ g. 246 m. 45 lo. 1,368 cars.  
E. S. Bowin, Gen. Man. .... Charleston, S. C.  
Ed. Parsons, Pur. Agt. .... New York, N. Y.  
J. H. Green, Supt. M. P. & M. C. B. Charleston, S. C.

Southern California Ry. (See A., T. & S. F. Ry.)

Southern Pacific Company and proprietary lines:  
4-8½ and 3 ft. g. 144.20 m. 3 ft. g. 6,572.25 m. 4-8½ g. 974 lo. 25,969 cars.  
J. Kruttschnitt, Gen. Man. San Francisco, Cal.  
F. W. Mahi, Mech. Eng. .... Sacramento, Cal.

Atlantic System.

W. G. Van Vleet, Man. .... Houston, Tex.  
J. J. Ryan, Supt. M. P. .... Houston, Tex.  
O. Trumphy, Pur. Agt. .... New Orleans, La.  
J. R. Cade, G. Pur. Car Dept. Houston, Tex.  
R. L. Herbert, M. M. .... Victoria, Tex.

Pacific System

J. A. Fillmore, Man. .... San Francisco, Cal.  
R. P. Schwerin, M. P. A. & S. S. Francisco, Cal.  
H. J. Small, Supt. M. P. .... Sacramento, Cal.  
B. Welch, M. C. B. .... Sacramento, Cal.  
H. Stillman, Eng. of Tests. Sacramento, Cal.

Western Div.

A. D. Wilder, Supt. .... Oakland Pier, Cal.  
Wm. McKennie, M. M. .... Oakland, Cal.

Sacramento Div.: J. B. Wright, Supt. Sacramento, Cal.

T. W. Heintzleman, M. M. .... Sacramento, Cal.

Salt Lake Div. J. Alger, Supt. .... Ogden, Utah.

E. M. Luckett, M. M. .... Ogden, Utah.

San Joaquin Div.:  
D. Burkhalter, Supt. .... Bakersfield, Cal.  
R. E. French, Asst. M. M. Bakersfield, Cal.

Los Angeles Div.:  
J. A. Muir, Supt. .... Los Angeles, Cal.  
P. Sheedy, M. M. .... Los Angeles, Cal.

Coast Div.:  
J. L. Fraser, Supt. .... San Francisco, Cal.  
F. L. Bates, M. M. .... San Francisco, Cal.

Yuma and Tucson Divs.:  
E. Randolph, Supt. .... Tucson, Ariz.  
R. W. Gray, M. M. .... Tucson, Ariz.

Shasta Div.: J. S. Noble, Supt. .... Dunsmuir, Cal.  
A. D. Kilborn, M. M. .... Dunsmuir, Cal.

Lines in Oregon:  
R. Koehler, Man. .... Portland, Ore.  
T. W. Younger, M. M. .... Portland, Ore.

Southern Ry. Co.  
4 ft. 9 in. g. and 3 ft. 4.489 m. 625 lo. 20,009 c.  
3d Div. Pres. .... Washington, D. C.  
W. H. Green, Gen. Supt. .... Washington, D. C.  
J. P. Minette, Pur. Agt. .... Washington, D. C.  
W. H. Thomas, Supt. M. P. .... Washington, D. C.  
J. H. Simpson, Supt. Car Service Washington D. C.

First Division:  
N. J. O'Brien, Supt. .... Danville, Va.  
W. H. Owens, M. M. .... Manchester, Va.  
C. F. Thomas, M. M. .... Alexandria, Va.

Second Division:  
W. B. Ryder, Supt. .... Charlotte, N. C.  
W. H. Hudson, M. M. .... Salisbury, N. C.  
W. A. Walden, M. M. .... Burlington, N. C.

Third Division:  
Paul I. Welles, Supt. .... Columbia, S. C.

Fourth Division:  
F. K. Huger, Supt. .... Knoxville, Tenn.  
J. B. Michael, M. M. .... Knoxville, Tenn.

Fifth Division:  
J. H. Barrett, Supt. .... Atlanta, Ga.  
W. L. Tracy, M. M. .... Atlanta, Ga.

Sixth Division:  
A. J. Fraser, Supt. .... Birmingham, Ala.  
W. A. Stone, M. M. .... Birmingham, Ala.  
Thos. M. Feeley, M. M. .... Selma, Ala.

Seventh Division (Southern Ry. to Ky.):  
G. R. Loyall, Supt. .... Louisville, Ky.  
V. B. Lang, M. M. .... Louisville, Ky.

Eighth Division:  
W. R. Beauprie, Supt. .... Macon, Ga.

Supplemental to Southern Ry., Alabama Great Southern Ry. 4-8½ g. 295 m. 59 lo. 3,611 cars  
C. A. Wickersham, Supt. .... Birmingham, Ala.  
C. Skinner, M. M. .... Birmingham, Ala.

Southwestern Ry. 3 g. 35 m. 4 lo. 55 cars.  
L. E. Barker, S. & P. A. Green Cove Springs, Fla.

South Florida R. R. (See Plant System.)

South Jersey R. R. 4-8½ g. 77 m. 8 lo. 40 cars.  
Francis I. Gowen, Receiver. Cape May, N. J.  
Jackson Richards, M. M. .... Camden, N. J.  
Chas. A. Beach, Gen. Supt. Philadelphia, Pa.

Spokane Falls & Northern Ry. Co. and Nelson & Ft. Shepard, Ry.  
4-8½ g. 200 m. 8 lo. 304 cars.  
Austin Corbin, 2d, Gen. Man. Spokane, Wash.  
O. D. Mott, Pur. Agt. .... Spokane, Wash.  
C. H. Prescott, M. M. & C. B. Spokane, Wash.

Staten Island Rapid Transit R. R.  
4-8½ g. 30 m. 18 l. 103 cars.  
Frank S. Gannon, Gen. Man. .... New York.  
W. H. Lewis, Pur. Agt. .... New York.  
Thos. Tyrrell, M. M. .... Clifton, S. I.

Stewartstown R. R. 4-8½ g. 7 m. 1 lo. 3 cars.  
M. W. Bahn, Gen. Man. .... Stewartstown, Pa.  
W. H. Fulton, G. S. & P. A. Stewartstown, Pa.  
J. B. Kennedy, M. M. .... Stewartstown, Pa.

Suffolk & Carolina Ry. 3-6 g. 39 m. 4 lo. 112 cars.  
Geo. L. Barton, G. Man., Pur. A. & M. M. Suffolk, Va.

Sumter Valley Ry.  
3 g. 25 m. 4 lo. 70 cars.  
David Eccles, Gen. Man. .... Baker City, Ore.  
J. A. West, Supt. & P. A. .... Baker City, Ore.  
F. W. Shurtliff, M. M. & C. B. Baker City, Ore.

Syracuse, Geneva & Corning. (See Fall B. Coal Co.)

Tennessee Midland Ry.: 4-8½ g. 135 m. 7 lo. 187 c.  
(See Paducah, Tenn. & Ala.)

Terminal R. R. Association of St. Louis.  
4-8½ g. 44 m. 26 lo. 62 cars.  
E. P. Bryan, Gen. Man. .... St. Louis, Mo.  
J. E. Williams, P. A. .... St. Louis, Mo.  
H. M. Smith, M. M. .... St. Louis, Mo.

Terre Haute & Indianapolis R. R.  
Vandalia Line.  
4-9 g. 663.65 m. 161 lo. 6,112 cars.  
J. J. Turner, F. P. & Gen. Man. St. Louis, Mo.  
C. R. Peddle, Pur. Agt. .... St. Louis, Mo.  
Wm. C. Arp, S. M. P. .... Terre Haute, Ind.  
C. Butler, M. M. .... Effingham, Ill.

Texarkana & Ft. Smith Ry.:  
4-8½ g. 68 m. 6 lo. 91 cars.  
F. S. Hammond, Gen. Man. Shreveport, La.  
Ira C. Hubbell, Pur. Agt. .... Kansas City, Mo.  
A. A. Campbell, M. M. .... Texarkana, Tex.  
J. T. Romack, M. C. B. .... Texarkana, Tex.

Texas Central Ry. 4-8½ g. 187 m. 10 l. 237 cars.  
C. Hamilton, Gen. M. G. S. & P. A. Waco, Tex.  
F. H. Dehn, M. M. .... Walnut Springs, Tex.  
P. T. Mooney, M. C. B. .... Walnut Springs, Tex.

Texas, Louisiana & Eastern R. R.:  
4-8½ g. 30 m. 2 lo. 20 cars.  
Samuel Lazarus, Gen. Man. .... Conroe, Tex.  
W. C. Beach, S. P. A. M. M. & C. B. Conroe, Tex.

Texas Midland Ry. 4-8½ g. 75 m. 6 lo. 186c.  
E. H. R. Green, G. M. & Pur. A. Terrell, Tex.  
B. Hanson, M. M. .... Terrell, Tex.

Texas & N. Orleans R. R. (See So. Pac.)

Texas & Pacific R. R. 4-8½ g. 1,490 m. 194 l. 4,554 c.  
L. S. Thorne, Gen. Man. .... Dallas, Tex.  
A. Gould, Pur. Agt. .... St. Louis, Mo.  
J. W. Addis, S. M. P. .... Marshall, Tex.  
W. D. Minton, M. C. B. .... Marshall, Tex.

Texas, Sabine Valley & Northwestern Ry.  
4-8½ g. 40 m. 3 lo. 28 cars.  
R. B. Levy, Sr., Rec. .... Longview, Tex.  
R. J. Evans, G. M. G. S. & P. A. Longview, Tex.  
T. M. Berry, M. M. & C. B. Longview, Tex.

Texas Trunk R. R. 4-8½ g. 52 m. 2 lo. 68 cars.  
Wm. Whyte, Rec., Supt. & P. A. Dallas, Tex.  
C. H. Burns, M. M. .... Houston, Tex.  
S. R. Tuggard, M. C. B. .... Houston, Tex.

Tionesta Valley R. R. 3 g. 62 m. 5 l. 273 c.  
Isaac Horton, Gen. Man. .... Sheffield, Pa.  
Jerry Cray, G. S., M. M. & C. B. Sheffield, Pa.

A. H. Bailey, Pur. Agt. .... Sheffield, Pa.

Toledo, Peoria & Western Ry.  
4-8½ g. 248 m. 40 l. 1,424 c.  
Ed. F. Leonard, President. .... Peoria, Ill.  
B. Warren, Pur. Agt. M. M. & C. B. Peoria, Ill.

Toledo, St. Louis & Kan. City R. R.  
4-8½ g. 451 m. 57 lo. 3,697 c.  
R. B. F. Peirce, Rec. & G. M. Indianapolis, Ind.  
A. L. Mills, Pur. Agt. & Supt. .... Toledo, O.  
Frank J. Fease, S. M. P. .... Frankfort, Ind.

Tuckerton R. R. 4-9 g. 29 m. 3 lo. 20 cars.  
John C. Price, Supt. .... Tuckerton, N. J.

Ulster & Delaware R. R.  
87 m. 4-8½ g. 23 m. 3 ft. g. 22 lo. 299 cars.  
Edward Coykendall, G. Supt. & P. A. Rondout, N. Y.

A. W. Belcher, M. M. .... Rondout, N. Y.

John Brenn, For. Car Rep. .... Rondout, N. Y.

Union Pacific system (4 Gen. Divs.)  
4-8½ g. 4,400.9 m. 705 lo. 17,286 cars.  
3 g. 39.5 m.

S. H. H. Clark, Oliver W. Mink, E. I. Ellery Anderson, John W. Doane, Fred. R. Couder, Receivers. .... Omaha, Neb.

E. Dickinson, Gen. Man. .... Omaha, Neb.

J. W. Griffith, Pur. Agt. .... Omaha, Neb.

J. H. McConnell, Supt. M. P. & M. C. B. Omaha, Neb.

E. Buckingham, Supt. C. B. Omaha, Neb.

A. M. Collett, Gen. Fore. Car. Dept. Omaha, Neb.

Neb. Div.:  
P. J. Nichols, Gen. Supt. .... Omaha, Neb.  
J. H. Manning, M. M. .... Omaha, Neb.

Wyo. Div.  
T. A. Davies, M. M. .... Laramie, Wyo.

Utah Div.:  
J. H. Young, Supt. .... Salt Lake City, Utah.  
J. F. Dunn, M. M. .... Pocatello, Idaho.  
Col. Div.: W. A. Deuel, Gen. Supt. .... Denver, Colo.  
Z. T. Sprigg, M. M. .... Denver, Colo.  
J. W. Blackburn, For. Car Reps., Denver, Colo.  
Idaho Div.: C. A. Boies, Supt. .... Pocatello, Id.  
Kan. Div.: J. O. Brinkerhoff, Supt. Kan. City, Mo.  
F. Mertsheimer, M. M. .... Armstrong, Kan.  
Union Pacific, Denver & Gulf Ry.  
4-8½ and 3 ft. g. 982 m. 92 lo. 2,932 cars.  
Frank Trumbull, Rec. & Gen. Man.,  
Denver, Colo.  
T. F. Dunaway, Gen. Supt. & Pur. Agt.,  
Denver, Colo.  
M. F. Egan, Supt. M. P. .... Denver, Colo.  
W. E. Fowler, M. C. B. .... Denver, Colo.  
Union Tank Line Co. .... 7,100 cars.  
J. Howard Wright, Pur. Agt., New York, N. Y.  
C. A. Smith, M. C. B. .... New York, N. Y.  
Utah Central Ry.  
8 g. 64 m. 8 lo. 156 cars.  
J. G. Bywater, M. M. .... Salt Lake City, Utah.

Vicksburg & Meridian R.R. (See Queen & Crescent.)  
Virginia & Truckee R.R. 4-8½ g. 52 m. 14 lo. 325 c.  
Hume Yerington, G. M. & P. A. Carson City, Nev.  
I. N. Fording, M. M. .... Carson City, Nev.  
C. Brulein, M. C. B. .... Carson City, Nev.

Wabash R.R.  
4-8½ g. 1,979 m. 418 l. 13,291 c.  
Jos. Ramsey, Jr., V. P. & Gen. Man.,  
St. Louis, Mo.  
J. B. Barnes, Supt. M. P. & M. Springfield, Ill.  
M. M. Martin, Supt. C. D. .... Decatur, Ill.  
H. H. Wellman, Pur. Agt. .... St. Louis, Mo.  
Wabash, Chester & Western R.R.  
4-8½ g. 65 m. 4 l. 102 c.  
C. B. Cole, Gen. Man. .... Chester, Ill.  
J. R. Hawkins, Gen. Supt. & P. Agt. Chester, Ill.  
Waco & Northwestern Ry.  
4-8½ g. 54 m. 5 lo. 91 cars.  
P. A. Gorman, G. M. & P. A. .... Waco, Tex.  
Alfred Abeel, Rec. .... Waco, Tex.  
Wagner Palace Car Co.  
W. S. Webb, Pres. .... New York, N. Y.  
J. D. Taylor, Treas. .... New York, N. Y.  
J. A. Spoor, Gen. Man. .... Chicago, Ill.  
J. G. Yager, Gen. Supt. .... New York, N. Y.  
E. A. Benson, Manager Buff. Wks., Buffalo, N. Y.  
Walkill Valley. 4-8½ g. 38 m. 3 l. 17 c.  
J. D. Layng, Gen. Man. .... New York, N. Y.  
A. Bourn, Pur. Agt. .... New York, N. Y.  
Wm. Buchanan, Supt. M. P. .... New York, N. Y.  
J. M. Boon, Asst. S. M. P. .... Frankfort, N. Y.  
Washington & Columbia River Ry. Co.  
4-8½ g. 162 m. 7 lo. 67 cars.  
W. D. Tyler, Pres., Gen. Man. & Pur. Agt.,  
Walla-Walla, Wash.  
J. M. Winslow, S. M. P. Walla-Walla, Wash.  
John Evans, M. M. .... Walla-Walla, Wash.  
Washington Southern Ry. Co. 4-8½ g. 76 m. 31 l. 118 c.  
J. R. McDonald, G. M. & S. .... Seattle, Wash.  
A. Johnson, Pur. Agt. .... Shelton, Wash.  
M. M. & C. B. .... Shelton, Wash.  
Waynesburg & Washington R.R. 3g. 29 m. 4 l. 53 c.  
C. E. Bower, Supt. .... Waynesburg, Pa.  
H. O. Hukill, Pur. Agt. .... Pittsburgh, Pa.  
A. M. Kline, M. M. .... Waynesburg, Pa.  
Western Maryland R.R. 4-8½ g. 288 m. 51 lo. 811 c.  
J. M. Hood, Fr. & Gen. Man. .... Baltimore, Md.  
H. M. Borgan, Pur. Agt. .... Baltimore, Md.  
David Holts, Mast. of Mach. Union Bridge, Md.  
D. E. Little, M. C. B. .... Union Bridge, Md.  
Balt. & Harb'g Div.: H. D. Scott, Spt. Hanover, Pa.  
H. S. Reiley, M. M. .... Hanover, Pa.  
Western New York & Pennsylvania Ry. Co.  
4-8½ and 3 g. 635 m. 150 l. 7,650 c.  
S. G. De Coursey, Pres. .... Philadelphia, Pa.  
Robert Bell, Gen. Supt. .... Buffalo, N. Y.  
J. H. Poole, Pur. Agt. .... Buffalo, N. Y.  
Allen Vall, M. M. & C. B. .... Buffalo, N. Y.  
Pitts. Div.: J. P. Heindel, Supt. .... Oil City, Pa.  
P. P. Foller, M. M. .... Oil City, Pa.  
Roch. Div.: C. T. Dabney, Supt. .... Olean, N. Y.  
John Magee, M. M. .... Olean, N. Y.  
West Jersey & Seashore R.R.  
(See Penn. R.R.; (3) Div.)  
Western Ry. of Alabama and Atlanta & West Point  
R.R. 4-9 g. 225 m. 33 lo. 603 cars.  
Geo. C. Smith, Pres. & Gen. Man. Atlanta, Ga.  
Joseph Herrin, Supt. .... Montgomery, Ala.  
Robert T. Pace, Pur. Agt. .... Atlanta, Ga.  
J. C. McCarty, M. M. .... Montgomery, Ala.  
West Shore R.R. (N. Y. C. & H. R. R. R. Lessee.  
4-8½ g. 489 m. 220 lo. 8,118 c.  
J. D. Layng, 2d V. P. Gen. Man. New York, N. Y.  
A. Bourn, Pur. Agt. .... New York, N. Y.  
W. Buchanan, Supt. M. P. & R. S. New York, N. Y.  
Jas. M. Boon, Asst. S. M. P. & R. S. Frankfort, N. Y.  
H. R. Div.: Jos. B. Stewart, Supt. Weehawken, N. J.  
J. Howard, M. M. .... New Durham, N. J.  
Buff. Div.: C. H. Ketcham, Supt. Syracuse, N. Y.  
P. E. Garrison, M. M. .... E. Buffalo, N. Y.  
W. Va. Cent. & Pitts'gh Ry. 4-8½ g. 163 m. 32 lo. 1,809 c.  
C. L. Bretz, Gen. Man. .... Cumberland, Md.  
W. H. Bower, Asst. Gen. Man. & Pur. Agt.,  
Elkins, W. Va.  
J. S. Turner, M. M. & C. B. Elkins, W. Va.  
W. Va. & Pittsburgh R.R. 4-8½ g. 160 m. 18 lo. 555 c.  
A. H. Kunst, G. Man. & Pur. A. Weston, W. Va.  
S. A. Steele, M. M. .... Weston, W. Va.  
White & Black River Valley Ry. 4-8½ g. 64 m. 4 l. 96 c.  
W. J. Thompson, Gen. Man. & P. A.,  
Little Rock, Ark.  
M. J. Redding, M. M. .... Brinkley, Ark.  
L. F. Hill, M. C. B. .... Brinkley, Ark.  
Wheeling & L. E. Ry. 4-8½ g. 249 m. 70 lo. 5,108 c.  
A. G. Blair, Pres. & G. M. .... Toledo, O.  
F. S. Deal, Pur. Agt. .... Toledo, O.  
M. C. B. .... Toledo, O.  
O. P. Dunbar, Gen. M. M. .... Norwalk, O.

Wichita & Western Ry. (Operated by A. T. & S. F. Ry.)  
Tb. Wiggins Ferry Co.; East St. Louis Connecting  
Ry.; St. Louis Transfer Ry.  
4-8½ g. 47 m. 14 lo. 30 cars.  
G. L. Sands, Man. .... St. Louis, Mo.  
C. L. Leslie, Pur. Agt. .... St. Louis, Mo.  
R. H. Johnson, M. M. & M. C. B. E. St. Louis, Mo.  
Williamsport & North Br. R.R. 4-9 g. 45 m. 7 l. 11 c.  
R. E. Eavenson, Gen. Man. & Pur. Agt.,  
Hughesville, Pa.  
Geo. Woodley, M. M. .... Hughesville, Pa.  
Wilmington & No'n R.R. 4-8½ g. 92 30 m. 29 lo. 410 c.  
Col. H. A. Du Pont, G. M. .... Wilmington, Del.  
A. G. McCausland, S. & Pur. A. Wilmington, Del.  
George Rommel, M. M. .... Wilmington, Del.  
Wilmington, Newbern & Norfolk Ry.  
4-9 g. 88 m. 4 lo. 75 cars.  
H. A. Whiting, Gen. Man. Wilmington, N. C.  
A. J. Howell, Jr. Fur. Agt. Wilmington, N. C.  
Geo. E. Branch, M. M. .... Wilmington, N. C.  
Winifrede R. R. 4-9 g. 10 m. 3 lo. 209 cars.  
R. B. Cassady, G. S. & P. A. Winifrede, W. Va.  
C. P. Spafford, M. M. .... Winifrede, W. Va.  
J. A. Bratt, M. C. B. .... Winifrede, W. Va.

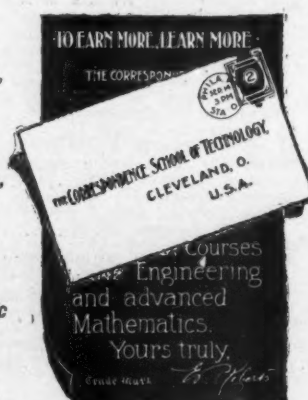
Winona & Western Ry.  
4-8½ g. 117 m. 7 l. 305 cars.  
J. J. Mahoney, G. Supt. & P. A. Winona, Minn.  
John Mallar, M. M. & M. C. B. Winona, Minn.  
Wisconsin Central Lines.  
4-8½ g. 892.43 m. 149 lo. 6,613 c.  
H. F. Whitcomb, Gen. Man. Milwaukee, Wis.  
Sumner J. Collins, Gen. Supt. Milwaukee, Wis.  
A. D. Allibone, Pur. Agt. .... Milwaukee, Wis.  
Jas. McNaughton, S. M. P. & C. Waukesha, Wis.  
Wm. Cormack, M. C. B. Stevens Point, Wis.  
Wisconsin & Michigan Ry. 4-8½ g. 70.62 m. 8 lo. 587 c.  
J. N. Faithorn, Gen. Man. & Pur. Agt.,  
Chicago, Ill.

Wood River Branch Ry. 4-8½ g. 5.7 m. 2 lo. 3 cars.  
L. M. Barber, S. P. A. & M. M. Hope Val. R. I.  
Wrightville & Tennite R.R. Co. 4-9 g. 36 m. 4 lo. 29 c.  
G. W. Perkins, G. M., Supt. & P. A. Tennite, Ga.  
W. H. Shepherd, M. M. & M. C. B. Tennite, Ga.

York Southern R. R.  
37 m. 4-8½ g. 4 m. 3 ft. g. 41 m. 6 lo. 90 cars.  
S. M. Manifold, G. M. & Pur. Agt., York, Pa.  
G. M. Jacobs, M. M. & M. C. B. .... York, Pa.  
Youghiogheny R. R. 4-9 g. 10 m. 2 lo. 1,205 cars.  
John F. Wolf, Gen. Man. & Gen. Supt. Irwin, Pa.  
T. F. Wolf, P. A. .... Irwin, Pa.  
Jno. Bricker, M. M. .... Irwin, Pa.  
J. W. Heintzelman, M. C. B. .... Irwin, Pa.  
John Rhoads, Supt. Car Dept. Philadelphia, Pa.

Zanesville & Ohio River Ry. 4-8½ g. 75 m. 7 lo. 196 c.  
J. H. Sutor, Rec. G. M. & P. A. Zanesville, O.  
J. Hope Sutor, Pur. Agt. .... Zanesville, O.  
Van Smith M. M. .... Zanesville, O.

Electrical,  
Steam,  
Bridges,  
Roofs  
AND  
Iron  
Structures,  
Surveying  
AND  
Roads,  
Mechanical,  
Hydraulic  
Engineering,  
Advanced  
Mathematics.



## ARGENTINE REPUBLIC.

ALBERT DONZEL and CHARLES THOMAS, Engineers and Contractors, working in the Argentine Republic over 20 years, having their office and house of consignment in Buenos Ayres, offer their services as Consignees and Representatives. Railway and Tramway Rolling Stock Equipment; Permanent Way; Well Sinking Machinery; Pumps; Windmills; Agricultural Machinery, both Steam and Horse Power; Fixed Engines and General Machinery; Decauville Road; Vehicles Propelled by Steam or Electricity; All Classes of Iron Girders for Building Purposes; T and Double L Iron Cranes; Steam and Hand Jacks; Screw and Hydraulic Pile Drivers; Steam and Hand and General Contractor's Plant. We invite all manufacturers wishing to utilize our services to remit us Catalogues, Drawings, Prices and Condition of Sale, etc. We also accept in consignment articles for sale of good manufacture.  
Address  
**CONGALLO 474,**  
Buenos Ayres, Argentine Republic.

## Railway Car Construction

200 PAGES. 500 ENGRAVINGS.

By WILLIAM VOSS.

With Full Working Drawings of Every  
Style of Car Now Used on American  
Railroads

Address . . . . .

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL,

Morse Building, New York.



## H. J. McKEOWN

MANUFACTURER OF  
Contractors' Plant,  
Stone Hoisting and  
Pile Driving Engines.

Crabs Derrick Irons

A SPECIALTY.

The Record on  
Price of this Hois-  
ing Engine need  
only to be investi-  
gated to commend  
it to every user.

196 E FRON T ST.,

Cincinnati, O.

Correspondence Solicited.



PERFORATED METALS  
FOR ALL RAILROAD PURPOSES.

## New Car Builder's Dictionary,

PRICE \$5.0

FOR SALE BY THE

AMERICAN ENGINEER,

CAR BUILDER & RAILROAD JOURNAL.

## GEO. L. FOWLER,

MECHANICAL ENGINEER,

53 Broadway, - - NEW YORK.

Special attention given to Designing, Testing  
and Constructing Railroad Machinery and Rolling  
Stock. Sole agent for Hale's Locomotive  
Ashpan.

# The Westinghouse Air-Brake Company

is now prepared to fill orders at an hour's notice for  
one or one thousand sets of **Air-Brakes** for  
**Freight Cars**, having at their new works an  
annual capacity for turning out air-brakes for . . .

**250,000 Freight Cars**  
**6,000 Passenger Cars**  
**10,000 Locomotives**

Besides repairs for the 450,000 Freight  
and Passenger Cars and 30,000  
Locomotives already equipped by . . .

# The Westinghouse Air-Brake Company

**CARBON STEEL CO.,**

Works at PITTSBURGH, PA.

MANUFACTURERS OF

OPEN HEARTH **STEEL** PLATES FOR ALL PURPOSES.

Specially Suited for LOCOMOTIVE Fireboxes and Boilers.

PARTICULARS SENT ON APPLICATION

909 Havemeyer Bldg., New York.

1413 Fisher Bldg., Chicago.

505 Union Trust Bldg., St. Louis.

... THE ...

**JANNEY COUPLERS.**

... MANUFACTURED ONLY BY ...

**THE McCONWAY & TORLEY COMPANY,**

48th St. &amp; A. V. Ry., Pittsburgh, Pa.

**RAILWAY CAR CONSTRUCTION.**

200 PAGES. :: 500 ENGRAVINGS.

By **WILLIAM VOSS.***With Full Working Drawings of Every Style of Car Now Used on American Railroads.*

... ADDRESS ...

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL, Morse Building, NEW YORK.

GENERAL LIBRARY,  
UNIV. OF MICH.  
4 DEC 1896

Sixty-Fifth Year.

Established 1832.

No. 12.

Vol. LXX.

# AMERICAN ENGINEER

CAR BUILDER AND RAILROAD JOURNAL.

NEW YORK:  
Morse Building, 140 Nassau Street.

DECEMBER, 1896.

{ \$2.00 PER ANNUM.  
SINGLE NUMBERS, TWENTY CENTS.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS MAIL MATTER OF THE SECOND CLASS.



## MAGNOLIA METAL

USED BY EIGHT LEADING GOVERNMENTS

The Best Anti-Friction Metal  
for all Machinery Bearings.

MAGNOLIA METAL CO.,

Owners and Sole Manufacturers,

74 Cortlandt St., NEW YORK.

Chicago Office, Traders Building.

London Office, 49 Queen Victoria St., London, E. C.

If you desire

**CARS** of Special  
Design . .

for any Special Service,

WRITE . . .

RUSSEL WHEEL  
& FOUNDRY CO.,

DETROIT, MICHIGAN.

## No. 98 High Back Seat.



Write for Late Catalogue.

THE BUSHNELL MFG. CO.

EASTON, PA.

## TURNBUCKLES



MADE BY  
Cleveland City Forge & Iron Co.,  
CLEVELAND, OHIO.

Branch Office: 136 Liberty St., N. Y.



## PERFORATED METALS

OF EVERY DESCRIPTION  
FOR ALL DEPARTMENTS OF

### RAILWAY WORK.

For use in Spark Arrestors, Extension  
Fronts, Deflector Plates, Etc. Perforated  
Brass, Bronze and Copper for Deck Sash  
Lights, Ventilators, Screens, Etc.

Perforated Tin and Brass of all Sizes.

THE HARRINGTON & KING  
PERFORATING CO.,

No. 218 NORTH UNION ST., CHICAGO.

EASTERN OFFICE—281 Pearl St., New York.

## AIR COMPRESSORS

VERSUS AIR BRAKE PUMPS.

CLAYTON AIR  
COMPRESSOR WORKS

SEND FOR  
CATALOGUE—26 Cortlandt St. NEW YORK.

**PRATT & LAMBERT,** Varnishes, Driers and Liquid Fillers.

Offices—NEW YORK, CHICAGO, MONTREAL.  
Factories—LONG ISLAND CITY, CHICAGO, MONTREAL.

**TAYLOR** STAYBOLT  
IRON **R. MUSHET'S**

SPECIAL  
and  
TITANIC  
STEELS.

Sole Representatives in the United States  
**B. M. JONES & CO.,**  
11 & 13 Oliver Street, BOSTON.  
143 Liberty Street, NEW YORK

**CLEVELAND TWIST DRILL COMPANY.**



New York Salesroom: No. 99 READE ST. Factory: CLEVELAND, O.

**HOWSON AND HOWSON,**

Counsellors at Law.

Solicitors of Patents.

119 South Fourth Street,  
PHILADELPHIA, PA.

New York, 99 Park Row.  
Washington, 916 F Street.



**SHEFFIELD CAR CO.,** SOLE  
THREE RIVERS, NICH.

**DROP** **FORGED**

465-471 Kent Ave., Brooklyn, E. D., N. Y.

**F. W. DEVOE & CO.'S** COLORS AND VARNISHES  
ARE STANDARDS.

# William Sellers & Co.

Incorporated, Philadelphia.



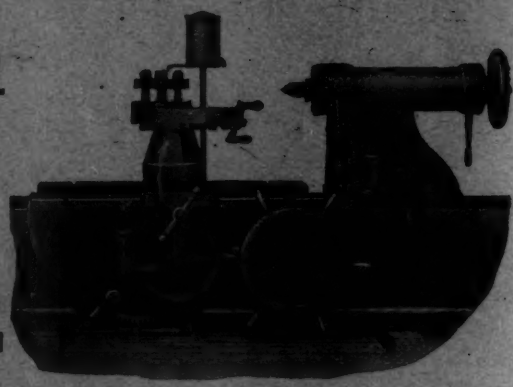
Improved  
Machine

## TOOLS

Traveling Cranes and  
Swing Cranes. . . .

Injectors, Turntables, Shafting.

Testing Machines, Smokeless  
Steam Hammers, Mechanical  
Etc. . . . . Stokers.



**Absolutely K. & M. Fireproof.**

# MAGNESIA

Sectional Steam Pipe and Boiler Coverings.

**THE GREAT COAL-SAVER.**

Manufactured by **THE KEASBEY & MATTISON CO., Ambler, Pa.**

CINCINNATI: 114 W. Second Street.  
LOUISVILLE: Am. Nat. Bank Bldg.

CLEVELAND: 117 Water Street.  
MINNEAPOLIS: Guaranty Loan Bldg.



## THE . . . Curtis Steam Pressure Regulator

Is a steam saving appliance which has been before the public 12 years, the constantly increasing sales of which are due only to its merits.

*It Is the Standard.*

Its Use Means a Saving in Operating Expenses.  
This Means Increased Earnings.

MANUFACTURED BY THE

**D'ESTE & SEELEY COMPANY,**

29-33 Haverhill St., Boston, Mass.

NEW YORK: 109 Liberty St.

CHICAGO: 218 Lake St.

## GEORGE PLACE, EQUIPMENT

—OF—  
**RAILWAY AND CAR WORKS**

Iron and Wood-Working Machinery  
Corliss Engines and Boilers.  
Shafting, Hangers, Pulleys, Etc.

120 BROADWAY, NEW YORK.

AGENT FOR

**J. A. FAY & EGAN CO.,**

BUILDERS OF

WOOD-WORKING MACHINERY

# THE MUTUAL LIFE INSURANCE CO. OF NEW YORK.

RICHARD A. McCURDY, President.

ROBERT A. GRANNISS, Vice-President.

ASSETS, \$221,213,721.33.



NASSAU, CEDAR AND LIBERTY STREETS,  
NEW YORK.

## A PERFECT SAVINGS BANK.

THIS great company has a MARITIME DEPARTMENT for promoting insurance upon the lives of seafaring men, *without extra premium charges of any kind*, giving seamen a free world-wide permit. Policies of every desirable form are issued for amounts from \$1,000 to \$100,000 on the lives of Captains, Mates, Surgeons, Pursers, Stewards, Engineers. Also Electrical and Stationary Engineers and dynamo tenders of one or more years' experience at regular rates.

CAPTAIN H. R. FREEMAN, late of the Cromwell Steamship Line, manager of this department, was instrumental in getting the Company to make the above concession in favor of Electricians and all seafaring men. All persons wishing insurance in the United States or Canada should make application in person or by letter to

CAPT. H. R. FREEMAN or his authorized Maritime Agent,

Mutual Life Building, No. 32 Liberty St., New York.

ESTABLISHED 1832.  
INCORPORATED 1882.

**VALENTINE & COMPANY**  
Manufacturers of High Grade  
Railway Varnishes  
and Colors.

TRADE

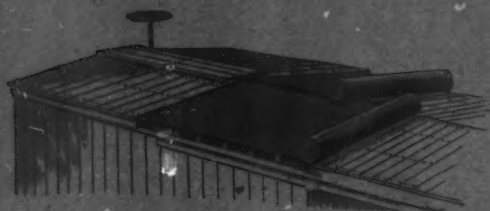
**VALENTINES**  
VARNISHES

MARK.

57 Broadway,  
NEW YORK.  
390 Wabash Ave.,  
CHICAGO.  
164 Purchase St.,  
BOSTON.  
21 Rue de Lappe,  
PARIS.

## I WONDER WHY

Sales of Hutchins' Plastic Car Roofs are increasing every day? Must be it's made of better material and costs you less. That's all anyone can expect.



Originators, Patentees and Manufacturers,  
**O. B. HUTCHINS & SONS, Detroit.**  
Chicago Office: 920 "ROOKERY."

## THE MORTON

Ball Bearing Screw Jacks and  
"SURE DROP" Track Jacks

ARE THE BEST IN  
THE WORLD.



**A. O. NORTON, Manufacturer,**  
336 Congress St., Boston, Mass.

## Steam Helve Hammers.

**THE CLEVELAND  
SHIP BUILDING CO.,**

No. 120 Viaduct, Cleveland, O.

Bound Volumes of the

**National Car and Locomotive Builder**

For 1895,

Price, - - - \$3.00.

**FIT UP YOUR WORKS  
WITH U. S. STANDARD**

**PUNCHES**

And Save Time and Money.

**I. P. RICHARDS, Providence, R. I.**



## RAILWAY CAR CONSTRUCTION.

The Only Perfect Work on American  
Cars Ever Published.

WRITTEN AND COMPILED BY  
**WILLIAM VOSS.**

200 Pages.

Upward of 500 Engravings.

Price, Postage Prepaid, \$3.00 per Copy.

Remit by Bank Check, Express Money Order,  
P. O. Money Order or Registered Letter.

## Cory Lubricator.

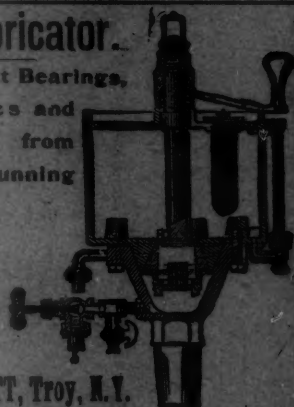
All important Bearings,

Eccentrics and

Links oiled from

Cab while running

Full Speed.



Manufactured by

**M. C. HAMMETT, Troy, N. Y.**

**AEUNA STANDARD IRON & STEEL CO.,**

BRIDGEPORT, OHIO.

MANUFACTURERS OF

Tin and Terne Plate, Iron and Steel Plates and  
Sheets, Plain, Black, Painted, Corrugated and  
other forms of Roofing, Siding and Ceiling,  
Patent Leveled Galvanized Sheets,  
Bars, Light Section Rails, Angles, Tees,  
Channels and other miscellaneous Bars and  
Shapes.

With such diversity of product, SPECIAL ad-  
vantages are offered buyers of mixed lots  
effecting saving in freight charges, and by  
reason of our LARGE STOCKS, securing  
PROMPT SHIPMENT.

Inquiries invited and catalogues mailed on appli-  
cation.

Boiler,  
Locomotive

AND  
Smoke Stack  
STEELS.

Quality Unsur-  
passed. Plates up  
to 118" in width

**SCHOENBERGER STEEL CO.,**  
PITTSBURGH, PA.

**FIRE**

**BOX**

**STEEL**

Purity,  
Ductility and  
Softness.

**Long & Allstatter Co.**  
HAMILTON, O.



SPICE-BAR PUNCH.  
Double, Single, Horizontal,  
Boiler, Spacing Gate, Multiple,  
Belt and Steam Driven

**PUNCHES AND SHEARS**

Send for New Catalogue OVER 300 SIZES.

Use Ajax Tin with Copper in place of Black Tin.

ESTABLISHED 1855

**AJAX BEARINGS**

90 MIL. & UP

EMPIRE STATE EXPRESS CO.

OUR SPECIAL

**AJAX TIN**

CAR, ENGINE & MACHINERY BEARINGS GUARANTEED

THE AJAX METAL CO., Philadelphia

SALES AGENCIES:

Chicago, Ill. - F. A. Lester & Co., 205 Old Colony Bldg.  
Richmond, Va. - Benj. F. Pilson, 20 Chamber of Commerce  
St. Louis, Mo. - C. W. Able, 217 N. Third St.

